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PATENT REFORM.

Elsewhere appears an account of a meeting held this week in Washington of representatives of various patent lawyers' associations and technical societies, having for a purpose the discussion of the subject of patent reform. As will be seen, the only result was a petition to Congress to defer action on patent bills now before it and a recommendation for further conferences of delegates from the bodies represented at Washington and from similar bodies which shall be invited to participate. The Washington meeting renders it evident that there will be difficulty in securing any effective concerted action through such a conference. The interests of patent lawyers, patent solicitors, inventors, manufacturers and the general public are by no means identical and are often decidedly conflicting. Moreover, the present unsatisfactory condition of the patent system is in the minds of many largely charged against the legal profession, and at the Washington conference this element appeared to dominate. It is regrettable that approval, or at least some encouragement, was not given to the recent proposal of the Inventors' Guild for the appointment of a commission to consider broadly the subject of patent monopoly and make to Congress recommendations as to legislation necessary to bring that monopoly, as now perverted by judge-made law, into conformity with the spirit of the constitutional provision designed solely to encourage inventors and benefit the public. We hope that at the next joint conference this plan will meet with better success, and that in the meantime every effort will be made to forward it regardless of this contingency. We hope also that Congress will proceed to immediate consideration of the measures now before it having for an object to nullify the Dick decision and to correct a few of the more glaring abuses of the patent system. As views for and against these measures can be presented individually by members of the joint conference at hearings on the bills, there appears to be no valid reason why they should be held up as requested by the Washington meeting. Measures introduced in Congress at this stage of a session have at best a precarious chance of passage, and delay would almost inevitably result in lack of legislation by the present Congress. Moreover, a psychological situation with relation to patent legislation similar to the present one might not confront succeeding Congresses for years.

THE ELECTRICAL EXPORT TRADE.

It is satisfactory to know that during 1911 our electrical exports reached the figure of not less than $19,355,536, the best total in many years, for one must go back to 1907 to find a total of $17,460,775. The increase was, however, rather in the varied class of appliances and instruments

than in that of heavy machinery, for the export of appliances was worth $11,008,012, while that of machinery was $8,347,524, the latter item being less by nearly $1,500,000 than the corresponding item in 1907. This is a significant indication of the tendencies of the times, and would imply that while the world is ready to accept with welcome our "Yankee notions" in a great variety of smaller goods, it does not crave excessively the heavier pieces of machinery. Europe is closed to the latter by protective tariffs or by cheaper production, and in the neutral markets she can meet us on terms of superior salesmanship as to price, quality and long credit. But if we go on as we are now doing, in developing an endless range of smaller apparatus in every branch of the industry, there seems to be no good reason why we should not continue to develop also the appreciative market for all that miscellaneous material.

The figures for January this year ran very much the same way, showing $1,045,636 for smaller apparatus and $675,633 for electrical machinery. For February the figures are $968,626 and $672,676, showing a slight gain in both groups over February, 1911. It takes very little to upset the balance month by month or to dislocate any careful attempt at comparisons. As an instance, it may be noted that of machinery Brazil took in February, 1911, only $2,873, whereas this year the figure was $143,728. He would not be a very wise man who predicated his analysis on such a wide range, explainable by a single large order. But we should all of us be warranted in hoping and in trying for a maintenance of the higher level, not only in Brazil, but in Japan, Canada, Africa, India and all the other markets to which our goods have entry, not so much because we have pushed them in, but because the demand would not be denied.

THE A. I. E. E. CODE OF PROFESSIONAL CONDUCT.

The American Institute of Electrical Engineers has recently promulgated a code of professional ethics, which was printed in full in our issue of March 16. The matter is one of great interest, and the action of the Institute appears in general to deserve commendation. The conduct of any professional man in general, and of any electrical engineer in particular, so far as it concerns human relations, comprises relations between himself, the public at large and his professional brethren. The great bulk of his relations toward the public at large are necessarily defined by the existing status of law and custom. Except in detail, these relations are the same as those of a merchant or of a business man to the community. The distinctive external relations of the professional man are those which define his conduct toward his professional brethren. His professional guild, society or institute has, theoretically, no right to impose upon him any interprofessional relations in contravention to general law and custom. That is, his professional brotherhood has no right to impose a lower level of ethical relations inside the profession than exists outside between members of the community at large. When law and custom say that men must act honestly in their mutual relations as members of a community, a professional brotherhood manifestly cannot maintain a lower ethical level within the brotherhood and support dishonest mutual professional relations.

But it lies within the powers of any professional brotherhood to adopt and maintain as much higher an ethical level of mutual internal relations, consistent with public duties, as it has a mind to. If it attempts to raise the interprofessional level too high, success will not justify the attempt, but the public will tend to recognize and honor a profession in proportion to the elevation of the interprofessional ethical level it can maintain with reference to the general public ethical level. In the older professions these internal declarations of professional ethics have been the foundations of professional honor and reputation. The Hippocratic vow of the medical profession established a code of interprofessional ethical relations for medicine in the fifth century before Christ and contributed greatly to the esteem in which that profession was held. From century to century these interprofessional ethics have varied with different professions, and in the same profession they have fluctuated in ethical elevation; but no profession is ever likely to secure and maintain public renown which does not set up some standard of internal dignity, self-sacrifice and self-denial of the members for the benefit of the profession. Opinions may differ as to the value, expedience or wisdom of individual articles, particularly those having a bearing on industrial relations, forming the code of professional conduct recently published by the American Institute of Electrical Engineers. Fortunately an ill-advised article advocating standardization was at the last moment eliminated. However, we think that the consensus of opinion will be that the principle of setting up such a code, assuming that it can be maintained, conduces to produce a distinctly uplifting force on engineering as a profession in the eyes of the public.

PARALLEL OPERATION OF GAS-ENGINE-DRIVEN ALTERNATORS.

The *Elektrotechnische Zeitschrift* has recently published an article, by Dr. Karl Czeija, upon the means that can be adopted in the design and operation of gas-engine alternator unites to secure smooth parallel running without hunting. The general theory of alternators operating in parallel on the same busbars is that each alternator has a natural period of electromagnetic oscillation when connected to a set of busbars, depending upon its electrical constants, its mechanical moment of inertia and the load which it carries. For one and the same machine the period of oscillation about the position of exact synchronism varies to some extent with the load. This natural period of oscillation may ordinarily be observed either by watching the angular velocity of the machine stroboscopically, or by connecting a vibration galvanometer, heavily shunted, to the circuit of the machine and watching the beats in its deflections. Under ordinary circumstances, if an oscillation in speed is accidentally set up in an alternator, it soon becomes absorbed, or damped out, by the electromagnetic power developed in the oscillation. If, however, the period of some impressed torque on the alternator shaft, as for instance that of an impulse in an engine cycle, happens to approximate closely the natural electromagnetic period of the alternator, then the tendency will be to accumulate oscillation energy faster

than it can be dissipated, and so to build up large and dangerous oscillations. In this condition an alternator is said to "hunt," and the hunting may be violent enough to throw the machine out of step. The remedy for such faulty tendencies is, on the one hand, to increase the dissipating or damping forces, whereby oscillations may become quickly smothered, as for instance by squirrel-cage windings embedded in the laminated field poles, and, on the other hand, to make sure in advance that no impulse frequency in the gas-engine cycle shall be able to coincide with the natural electromagnetic period of the alternator at any normal condition of load.

THE MELTING POINTS OF TUNGSTEN AND TANTALUM.

With the introduction of metal-filament lamps has come a renewed interest and activity in the study of the radiating properties of metals in general, and of those metals in particular which have proved useful in incandescent-lamp manufacture. To the casual observer it may seem to be a question of purely academic interest whether the relatively high efficiency attainable in the tungsten lamp is to be ascribed to a correspondingly high temperature of operation or, rather, to what has been termed *selectivity* in its radiation. By selective radiation, as used here, is meant that a disproportionately large amount of the radiant energy emitted by the substance at any given temperature is concentrated in the visible spectrum, producing a disproportionately high efficiency for the temperature of operation. That this interest in arriving at the true explanation of efficiency, far from being purely academic, is stimulated rather by the most practical considerations is appreciated by anyone who contemplates the surprisingly low actual efficiencies of our common light sources. When one considers that if all the energy transformed in a tungsten lamp were converted into luminous radiation in the yellow-green region of the spectrum its output would be of the order of magnitude of 800 lumens per watt instead of only 8 lumens per watt, that the efficiency of the flaming arc is only 5 or 10 per cent of the highest attainable efficiency, he is convinced of the real need of a closer study of the radiating properties of matter.

As a result of the various researches that have been undertaken, certain definite conclusions have been reached. It has been shown that the metals tantalum, tungsten and osmium all exhibit the property of selective radiation. Yet even for these metals, with the possible exception of osmium, the selectivity is not so marked but that the actual temperatures at which the respective lamp-filaments operate are in excess of that of the so-called 3.1-watt carbon lamp. The tungsten lamp probably operates at a temperature of 2200 deg. to 2500 deg. absolute (C. + 273 deg.), which is somewhat higher than that of the carbon lamp, and yet the melting point, or rather the boiling point, of carbon is estimated at 3800 deg. to 4000 deg. absolute. Owing to the rapid vaporization even at relatively low temperatures, carbon cannot be operated satisfactorily at a higher output than 4 lumens per watt (2.5 watts per candle), as in the graphitized carbon lamp. It is, therefore, of much interest to determine the melting points of such substances as tantalum and tungsten, which operate at higher temperatures than carbon, and yet for which previous experiments have indicated melting points 600 deg. or 800 deg. below the temperature attained by solid carbon in the arc crater.

Mr. Forsythe has quite recently published the results of an investigation carried out in the physical laboratory of the University of Wisconsin which had for its object the determination of the melting points of tungsten and tantalum. The values obtained by Mr. Forsythe for the melting points of these two substances are approximately 3200 deg. and 3075 deg. absolute respectively. These metals have true melting points, and if an attempt is made to heat them beyond these temperatures a true melt with a well-defined bead results. In contrast with these substances a carbon filament cannot be made to develop a bead; it has no true melting point. As the temperature is increased sublimation takes place more and more rapidly, but by quickly increasing the voltage applied to the ends of a filament it is possible to secure and approximately measure temperatures of the order of magnitude of the melting point of tantalum. Beyond 3200 deg. absolute the disintegration through sublimation occurs so rapidly that no measurements can be made using an ordinary lamp filament, but it is quite possible that a temperature well in excess of this may be attained momentarily at the point of rupture. An output of 30 lumens per watt (0.4 watt per candle) has actually been observed, and yet an ordinary flashed carbon lamp will not operate satisfactorily at one-half the efficiency of the tungsten lamp. The rapid sublimation of carbon is the explanation of this condition, but the possibilities of reducing the rapid sublimation, and therefore of making possible higher temperatures of operation, offer an interesting field for speculation and experiment. The flashing process made possible the so-called 3.1-watt carbon lamp in place of the old 4-watt untreated filament, and the graphitizing process developed the 2.5-watt carbon-filament lamp. It is not improbable that much improvement in the incandescent lamp in the future will result from the development of methods of utilizing known filament materials at temperatures more closely approaching their melting or boiling points. Until commercial illuminants have absolute efficiencies well in excess of 5 per cent or 10 per cent, or even 50 per cent, the investigation of the radiating properties of matter will continue to be of more than academic interest and should engage the best thought of competent investigators.

ELECTRICAL INSTRUMENT SPECIFICATIONS.

An article by Dr. H. Hausrath has recently been published in the *Elektrotechnische Zeitschrift,* which analyzes in detail the properties and limitations of standard electrical measuring instruments, with a view to enabling accurate and complete industrial specifications to be written for the duties and performances of any such instrument. Sixteen such qualifications are defined. There can be no doubt that the absence of adequate specification details interferes with the production and supply of the right type of instrument to meet a given set of practical requirements. Whether the particular set of qualifications offered is the best for regular use is a matter for discussion; but any definite systematic set of standardization qualifications would be better than none.

JOINT PATENT CONFERENCE.

In response to the recent call issued by the Patent Law Association of Washington, D. C., there was held in Washington on April 15 and 16 at the Cosmos Club a joint conference to consider the patent bills now pending in Congress and to discuss the patent situation in general, the following societies being represented: For the American Chemical Society, Mr. Clinton P. Townsend and Prof. Charles E. Munroe, both of Washington, D. C.; for the American Electrochemical Society, Dr. L. H. Baekeland of Yonkers, N. Y., and Mr. A. B. Marvin of Chicago; for the American Institute of Electrical Engineers, F. P. Fish, Esq., of Boston, Dr. M. I. Pupin of New York, Mr. A. W. Berresford of Milwaukee and Prof. D. C. Jackson of Boston; for the American Institute of Mining Engineers, Captain A. F. Lucas of Washington, D. C.; for the American Society of Mechanical Engineers, Mr. B. F. Wood of Altoona, Pa., and Mr. William H. Blauvelt of Syracuse, N. Y.; for the Chemists' Club of New York, Mr. Carleton Ellis of New York; for the American Institute of Chemical Engineers, Dr. William M. Grosvenor and Dr. Maximilian Toch, both of New York; for the Inventors' Guild, Mr. H. Ward Leonard and Mr. Ralph D. Mershon, both of New York; for the Patent Law Association of Washington, Mr. Walter F. Rogers and Mr. William W. Dodge, both of Washington, D. C.; for the Patent Law Association of Chicago, Mr. Thomas F. Sheridan of Chicago; for the New York County Lawyers' Association, and including also non-resident members of the Washington association, Mr. William H. Kenyon, Mr. Alfred W. Kiddle and Mr. Robert C. Mitchell, all of New York; Mr. Odin Roberts and Mr. George O. G. Coale, both of Boston, and Mr. E. W. Bradford of Washington and Indianapolis. The American Society of Civil Engineers was invited to send representatives, but did not do so.

The conference selected Mr. Walter F. Rogers as chairman and Mr. Ralph D. Mershon as secretary, and then proceeded to a consideration of the pending bills in Congress which relate to patent affairs. Eliminating some ten bills which have been drawn to relieve certain specific situations of a private nature, there are slightly over forty bills which deal with the patent and copyright laws. It was the universal sense of the conference that the pending bills should be delayed until the societies and associations represented could be fully heard by the patent committees of Congress. A very free discussion of the present situation took place, bringing out the positions taken by the delegates individually and by the societies or associations they represented. In view of the fact that the conference was called essentially for the informal exchange of views and opinions, it was considered that authority was lacking for any formal action and therefore it was decided to recommend the formation of a standing joint committee with full powers. Accordingly the following resolution was unanimously adopted:

"At a meeting of representatives from the following associations held at Washington on April 15 and 16, 1912, over forty bills affecting the patent system of the United States were considered to such extent as time permitted. Many of these bills are obviously of radical character—aimed at fundamental principles of the patent system—and others deal with such complicated matters as Patent Office procedure and practice.

"After extended discussion, in view of the importance of careful consideration of the said bills, to the end that the patent system of the United States, to which in so large a measure our industrial prosperity is due, may not be unduly affected, it was unanimously resolved, that the representatives of the several associations there represented agree to recommend to their respective associations:

"That the committees of Congress be respectfully urged to defer action on said bills until the associations represented at the conference and the public generally have had ample opportunity to study the bills and determine what may be the full effect of the changes contemplated by them.

"That a recommendation be made to the respective associations to appoint members of a joint standing committee with power, subject to the call of the chairman of the Patent Law Association of Washington, to study the pending bills and the whole patent situation and adopt means for such action as may appear expedient."

Subsequent discussion arose in reference to the propriety or desirability of inviting other national societies to join in the future conferences, in order to bring together all interests in the patent situation. This resulted in the adoption of another resolution, which follows:

"Resolved, That the associations here represented, and such associations as shall be hereafter added thereto, shall appoint, each, three delegates, each association to have one vote, and that a committee, consisting of Mr. Rogers, Dr. Baekeland and Mr. Mershon, shall be appointed, which may add at its discretion associations and members to meet in future joint conferences."

This committee was also empowered to call future meetings, specifying the time and place. After reviewing the provisions of Mr. Oldfield's bill, H. R. 23,193, which it is said was prepared by Patent Commissioner Moore and which provides for numerous changes in the present patent laws, the conference adjourned.

BILL FOR RECODIFICATION OF THE PATENT LAWS.

On April 11 Chairman Oldfield of the House committee on patents introduced a long bill (H.R. 23,193) which provides for fundamental changes in the patent laws. The most important provisions are described in what follows. While the present Patent Office is under the jurisdiction of the Department of the Interior, the new bill changes this and makes the Commissioner of Patents accountable only to the President. Provision is made for a commissioner of patents, a first assistant commissioner, an assistant commissioner and three examiners in chief, all appointed by the President with the consent of the Senate. All other officers and employees of the department are to be appointed by the commissioner. Full power is bestowed upon the commissioner to perform all duties respecting the granting and issuing of patents as directed by law. The six officials above named are to constitute a board of appeals, a quorum being constituted by any three.

Every patent is required to contain a short title or description of the invention or discovery, and will contain a grant to the patentee of the exclusive right to make, use or vend the invention or discovery throughout the United States and its territories for a term of seventeen years, but every patent shall be so limited as to expire nineteen years from the date of filing the application, exclusive of the time actually consumed by the Patent Office or the courts in considering the application. If at any time during the term of a patent, except the first four years, the invention ceases to be manufactured or the process carried on to an adequate extent, then any person demanding it shall be entitled to a license from the owner of the patent to manufacture the invention or carry on the process, unless the owner can show sufficient cause for inaction. Upon refusal of the owner, the person seeking such license may apply to the district court having jurisdiction. The court will hear the case, and if satisfied that an application should be granted will order the issue of a license and will stipulate the royalties or payment therefor. An appeal may be taken from the order of the district court to the circuit court of appeals.

The definition of a patentable invention is set forth in Section 19 of the bill, as follows: "Any person who has invented or discovered any new and useful art, machine,

manufacture, or composition of matter, or any new and useful improvements thereof, not known or used by others in this country before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof or more than two years prior to his application, and not in public use or on sale in this country for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law and other due proceeding had, obtain a patent therefor." Foreign applications, unless made more than twelve months before domestic applications, are of no effect, but no patent may be granted for an invention or discovery which has been patented or described in a printed publication in this or any foreign country more than two years before the date of application, or which has been in public use or on sale for more than two years prior to such application. In case of rejected claims the law now allows one year during which the applicant may file amended claims, but the Moore bill reduces this period to six months. If the application is forfeited by non-payment of dues, renewal must be made within one year, instead of the present limit of two years.

Section 32 of the bill is intended to correct the defects in the present law, as exemplified in the Dick decision, and the principal clause reads as follows:

"Any person who purchases of the owner of a patent, or of any interest therein, any machine, manufacture, or composition of matter, covered by such patent shall have the unrestricted right to use, vend or lease to others to be used the specific thing so purchased without liability to action for infringement; and any person who obtains a license of the owner of a patent, or of any interest therein, to use any art, machine, manufacture, or composition of matter, covered by a patent shall have the unrestricted right to use such art, machine, manufacture, or composition of matter, without liability to action for infringement."

The bill also provides for the issue of a certificate of correction whenever, in the opinion of the commissioner, a patent issued by the Patent Office does not conform to the records and files of that office. The total fee for a patent, which is now $35, is not changed, but the new bill makes the initial fee $20 and the issuing fee $15.

MARCONI LECTURE BEFORE NEW YORK ELECTRICAL SOCIETY.

The oldest electrical society in America held the most enthusiastic meeting of its existence on April 17, when Dr. William Marconi delivered a highly instructive lecture upon the timely topic, "Recent Developments in Wireless Telegraphy." The speaker outlined the early work leading to the discovery of the principles upon which the production and detection of wireless messages depend, giving full credit to Maxwell, Ampère, Faraday and Hertz. He explained the advantageous features of tuning the interrelated circuits so as to possess the same inherent natural vibratory period, and employing loose electromagnetic coupling between the mutually related circuits in order to avoid the production of detrimental superposed vibrations. The speaker expressed the opinion that no other single development in wireless telegraphy equaled the demonstration in 1901 that the curvature of the earth does not of itself tend to limit the distance of transmission of ether waves used in wireless communication, although it places a definite limit to the transmission of ether waves visible to the eye.

Dr. Marconi mentioned the fact that the ultra-violet rays in sunlight act on wireless waves just as does fog on light waves, the effect being greater the shorter the wave-length. On this account messages can be sent more easily at night than during the daytime and in cloudy weather than in clear sunlight. It has been noted that the damping effect of sunlight is even greater when either the sending or the receiving station is in darkness than when both are in sunlight, this result being due to the defraction of the waves at the surface separating darkness from sunlight. The fact that messages can be sent more freely over sea than over land is attributable to the greater and more uniform electrical conductivity of the surface of the ocean compared with the land surface.

Dr. Marconi closed his lecture with a reference to the striking statement that Nature has provided in wireless-telegraph phenomena both advantages and disadvantages, the advantages always outweighing the disadvantages in connection with the most urgent communications. Under the conditions existing when communications are most desirable and difficult to obtain in any other way, namely, night-time, foggy weather, over troublesome seas, wireless telegraphy is at its very best in every respect.

Prof. M. I. Pupin, in a highly eulogistic speech, proposed that Dr. Marconi be elected an honorary member of the New York Electrical Society. In seconding this proposal, Mr. Frank J. Sprague visibly affected Mr. Marconi when he credited him with saving the lives of from 700 to 800 persons rescued from the ill-fated *Titanic* by means of wireless telegraphy. This proposal was enthusiastically indorsed by all members present.

N. E. L. A. YELLOWSTONE PARK SPECIAL.

In connection with the Seattle convention of the National Electric Light Association considerable inquiry in regard to the possibility of visiting the Yellowstone Park on the homeward trip has arisen on the part of those who will not be traveling by the special trains de luxe that make the park one of the objective points of their itinerary. With the assistance and advice of Mr. Charles H. Hodskinson, master of transportation, the Northern Pacific Railway has organized a special excursion party for the Yellowstone National Park, the train to be known as the Yellowstone Park Special, which will make the trip thither two days after the close of the convention, namely, on Sunday, June 16, continuing thence by way of Minneapolis, St. Paul and Chicago. If 100 or more people make the trip the special will be a definite certainty, and if less than that number are enrolled they will be handled on the same schedule in extra equipment on the North Coast Limited. Aside from transportation the Yellowstone Park tour will cost only $55.50 for the complete five-and-one-half day trip into and out of the park.

DISTRICT HEATING ASSOCIATION CONVENTION.

The National District Heating Association will hold its fourth annual convention in Detroit, Mich., on June 25, 26 and 27. Among the papers to be presented are the following: *Common Sources of Trouble in Customers' Installations,* by Mr. William E. Darrow, of the Merchants' Light, Heat & Power Company, Indianapolis; *Quality of Steam as Served by Central Stations to Their Customers,* by Mr. A. C. Shepherd, of the Cleveland Electric Illuminating Company, Cleveland, Ohio; *An Analysis of Heating Rates,* by Mr. A. E. Duram, of the Central Station Engineering Company, Chicago, Ill.; *Heating in Connection with Curtis Steam Turbines,* by Mr. August H. Kruesi, of the General Electric Company; *Description of a Combined Steam-Heating, Ice-Making and Electric-Power System,* by Mr. J. T. Lewis, of the Murphy Heating Company, Detroit, Mich.; *Description of a Large Hot-Water System,* by Mr. G. E. Chapman, of the Public Service Company, Chicago, Ill.; *De-centralized Steam Plants,* by Mr. S. M. Bushnell,

Chicago, Ill.; *Depreciation in Underground Distribution Plants,* by Mr. W. Jennings, of the Harrisburg Steam Heat & Power Company, Harrisburg, Pa., and *The Economic Survey of Combined Power and Heating Systems,* by Mr. E. B. Dreyfoos, of the Westinghouse Machine Company, Pittsburgh, Pa.

HYDROELECTRIC DEVELOPMENT IN MISSOURI.

Constructive operations are now under way for the first hydroelectric development along the White River in the Ozark Mountains of Missouri, noted on page 432 of our issue dated Feb. 24. Additional sites are being considered, and it is expected that ultimately power from this stream in the neighborhood of 45,000 hp will be harnessed. The Ozark Power & Water Company contemplates the development of at least one additional site within the next two years. The initial 15,000-hp generating station is being erected near Forsyth, Mo., on the White River. Energy will be generated for transmission at 66,000 volts, and the high-tension transmission system planned comprehends 43 miles of line extending to the city of Springfield, Mo., and 80 miles of line running from Springfield to Joplin, Mo.

The electrical equipment in the main power house consists of five 2250-kva, 2300-volt generating units, each directly connected to a pair of wheels, two 175-kw exciters, seven 2000-kva, 66,000-volt transformers and a switchboard. The substation at Springfield will contain four 1550-kva, 66,000-volt transformers, a switchboard and all necessary protective devices. All of this apparatus will be furnished by the General Electric Company. It is anticipated that the completion of the plant will be accomplished early in next year and that it will be in full operation by April.

APRIL MEETING OF THE NEW YORK SECTION, I. E. S.

Messrs. Warner M. Skiff, Cleveland, Ohio, and L. C. Porter, Harrison, N. J., were the authors of two papers presented at a meeting of the New York Section of the Illuminating Engineering Society held on April 11. Mr. Skiff outlined the methods employed at the laboratory of the National Electric Lamp Association for insuring accuracy in the testing of incandescent lamps. At each step in the testing routine two observers working independently must obtain identical results before the test is considered satisfactory. Every error detected is credited to the person detecting it and debited to the one making it, and in this way a spirit of good-natured rivalry is produced.

Mr. Porter described the results of a study made of the lighting arrangements employed on ferryboats, coastwise ships, river steamers and transatlantic liners. Tests showed an illumination density on ferryboats varying from 0.8 to 2.3 ft.-candles in the upper cabins and from 0.6 to 3.3 ft-candles in the lower cabins. On river, lake and coastwise steamers the illumination varied from 0.6 ft-candles in staterooms to 2.8 ft.-candles in dining-rooms. On transatlantic liners the illumination varied from 0.4 ft.-candles in the third-class smoking-room to 4.2 ft.-candles in the first-class writing-rooms.

These papers were discussed briefly by Dr. Louis Bell and Mr. Norman Macbeth. Mr. A. J. Marshall, as secretary of the section, announced that at the meeting to be held on May 2, when Messrs. Bassett Jones, Jr., and Henry Horncastle will present a paper entitled "The Relation of Shadow and Color in Design," the effects described by the authors will be illustrated by means of a model showing variation of shadow and color with change in position of light source and in the quantity and quality of light.

MISSOURI ELECTRIC ASSOCIATION.

The sixth annual convention of the Missouri Electric, Gas, Street Railway and Waterworks Association was opened at the Hotel Conner, Joplin, April 11, by President F. E. Murray, of Louisiana, Mo., the address of welcome being delivered by Mayor J. F. Osborn of Joplin, who was introduced by Mr. George Hayler, general superintendent of the Empire District Electric Company. In commenting on his own position as the buffer between the public and the utility corporations, Mayor Osborn admitted that he could often see the scientific arguments of the latter more easily than the partisan views sometimes held by the people, although he reminded the convention that, after all, the public is the utility company's silent partner and greatest asset.

At the afternoon session Mr. R. A. MacGregor, power agent for the Empire District company, read a paper on the motor-service development of the southwest Missouri lead and zinc district, in the preparation of which he had the collaboration of Messrs. W. O. Custis, J. G. Horgan, C. B. Rhodes and J. R. Busey, specialists in the power department. Mills in which electric drive is used save money over the ordinary cost of 6 cents per ton of dirt handled, the grade of ore obtained is improved, and the ore values left in the trailing piles are reduced to 0.50 and 0.75 per cent. Electric drills of the rotating-hammer type have been tried thoroughly in the Joplin field, but are found hardly successful in the flint rock encountered, owing to failure of the steel drill shafts under the impact of the hammer blows. Since mine development is extremely speculative, owners usually confine their investments to the minimum amount possible and prefer to install the less expensive air drills.

Mr. F. N. Jewett, Wagner Electric Manufacturing Company, St. Louis, followed with a paper on "The Unity-Power-Factor, Single-Phase Motor," illustrating the advantages and reduced distributing investment of 100 per cent loads and suggesting that by a suitable system of power-factor credits the customer be allowed to share in the profits resulting from desirable circuit conditions. He also exhibited curves showing the comparative number of motors served by a given generator rating at different power-factors, the effect of power-factor on regulation, the relative losses of three-phase and single-phase distributions, and the comparative line and meter investments required. Mr. Hugo Wurdack, St. Louis, referred to the limited starting torque of certain single-phase motors, and Prof. H. B. Shaw, Columbia, urged that the cost comparison of single and polyphase distribution be carried further back so as to include the generating equipment.

Mr. Hugh L. Cooper, chief engineer of the Mississippi River Power Company, gave an entertaining illustrated account of the work of building the 200,000-hp water-power plant at Keokuk. The first turbines are now being put in place and will be ready to run early in 1913. Referring to the recent ice jam, Mr. Cooper showed photographs of the ice piled flush with and over the 25-ft. cofferdam. This jam was followed by a flood which rose within 3 in. of the top of the dam and then receded without damage. The ability of temporary structures to withstand such attacks, he pointed out, should be convincing proof that the permanent parts will meet any extreme river conditions ever likely to occur in the future.

In executive session Friday morning the association voted to rescind its action of last year when it admitted municipal plants to membership. Mr. Hermann Spoehrer, St. Louis, opened the technical program with his paper on "Electric Rates." A non-discriminating system of charges, he said, is one by which the customer pays in proportion to the cost of supplying his service. Of this cost, 15 to 20 per cent, due to generation and distribution, is proportional to output, and 50 to 60 per cent to maximum demand. Al-

though steps in the right direction, the "connected-load" and "demand" systems of charging have grave disadvantages. The latter, for instance, requires extra recording-meter investment, additional reading of meters, and offers another source of customers' disputes. Charging by "connected load" involves difficulties of keeping correct records, the annoyance and cost of frequent inspections, discouragement of "convenience" outlets, and encourages the overloading of motors. Mr. Spoehrer described the "area" charge used by the Suburban Electric Company in St. Louis County, and outlined the new "room" rate of the St. Louis Union Electric Company and the methods of computing the elements of this modified "demand" system. The area plan, said the speaker, will shortly be extended to commercial lighting in St. Louis. In closing, Mr. Spoehrer urged more national uniformity in the principles of electric rate making, in this way increasing the confidence of the public, and especially that of the growing class of national electricity users who buy service in a number of different communities.

Mr. G. B. Merrill, Cleveland, Ohio, said that when using an area rate the company should reserve the right to make a demand charge, applicable to electric stoves, etc. Mr. Hugo Wurdack, St. Louis, declared that such stove demands are largely off-peak and are sufficiently desirable at these times to offset their peak penalty. Mr. A. C. Einstein, St. Louis, stated, as his own honest conviction, the belief that central-station companies are no more justified in charging a minimum bill than a department store would be in charging its customers $1 a month to meet the cost of selling them its goods, following up credits, etc. But the merchant, continued Mr. Einstein, wisely takes the large view of the matter, applying the law of averages to cover individual readiness-to-serve expense and loss. In closing, the speaker declared that the electrical business will not reach its fullest development until the companies cease adding such penalties for their customers to pay. Mr. J. E. Harsh, Joplin, insisted that, however the law of averages may apply to the great metropolitan companies, the little plant cannot afford to operate without a system of minimum charges. Mr. F. E. Murray said that in his own city of Louisiana, where minimum charges are not allowed, electric-iron and heating-appliance campaigns have been used with good effect to increase customers' bills beyond even the usual $1 minimum charge.

Prof. H. B. Shaw's paper on "Electric Pumping" pointed out the desirability of this service from the central-station standpoint, on account of its high load-factor and comparatively larger summer use. For water-works service the ease of measuring electrical energy makes simple analyses of pumping costs. Prof. Shaw also related some experiments with a test well whose level was found to be drawn down 0.4 in. for each gal. of water pumped per minute. In another well tests showed the static level to have risen during a term of years. An exhibition of pump characteristics, shown by curves, was included in Prof. Shaw's paper. Mr. P. W. Markham, of Brookfield, said that ten wells, formerly steam-driven at a cost of 9 cents per 1000 gal., are now electrically driven by 5-cent energy at a cost of 5 cents per 1000 gal. Mr. George Hayler, Joplin, said that more than 100 electrically operated pumps are in use in the Empire mining district, lifting against heads up to 225 ft. Owing to the changing conditions of mine service, it is difficult to select units precisely for the work required of them. He also called attention to the peculiar characteristics of centrifugal pumps, which when operated at partial head will deliver more than a proportionally increased output, resulting in overloading and sometimes burning up the motor. Mr. R. A. MacGregor, Joplin, spoke with favor of the performance of triplex pumps under many conditions, citing an instance where one such unit, working against 250 ft. head, showed an over-all wire-to-water efficiency of 81 per cent.

"Lighting and Power in Rural Districts" was discussed by Mr. P. W. Markham, of Brookfield. The farmer, said the speaker, is naturally of a suspicious and "show me" class and must first be convinced of the saving that is possible with electricity. Among special farm uses of motive power Mr. Markham mentioned cold storage to hold crops for higher prices, operation of electric plows and harrows, stimulation of vegetation, etc. Practical demonstrations made with a motor on a wagon, he suggested, might help educate the rural resident. Mr. Markham also cited figures on farm service at Elmwood, Eureka and Petersburg, Ill., and other places which have been reported in these columns. Mr. J. T. Buchanan, Chicago, said that the manner of getting the electricity out to the farm has not received its share of attention. There is a limit beyond which it is not profitable to tap small consumers onto a high-tension transmission, for above 13,200 volts the cost per kw of transformers mounts rapidly. A flexible system for transformer connections, said Mr. Buchanan, is that used by the Public Service Company of Illinois, which employs three-phase, four-wire, 8000-volt construction. Prof. H. B. Shaw, Columbia, called attention

PRESIDENT-ELECT P. A. BERTRAND.

to the extensive use of electricity on German farms and enumerated recent publications issued by the University of Missouri on the subject of country-house conveniences.

"Liability Insurance" was the subject of Friday afternoon's address by Mr. L. J. Block, of the Utilities Indemnity Exchange, St. Louis. The speaker outlined a plan of reciprocal or mutual insurance now being carried on among utility operators. Each company contributes to the treasury the amount of its old-line premium, 30 per cent of which goes to management expense and 70 per cent to pay losses. Half of the surplus remaining to each subscriber's credit at the end of a year is returned to him in cash, the other half being carried to his credit until the sum equals his annual deposit, when the whole is returned. In case of excessive losses subscribers hold themselves liable for twice their yearly deposit. The affairs of the exchange are administered by a board of the subscribers.

At the executive session of Saturday morning President Murray appointed committees as follows: Nominating—C. L. Clary, Sikeston; R. J. Irvine, Moberly, and S. J. Duncan, Mexico. Resolutions—H. B. Shaw, Columbia; H. Spoehrer, St. Louis, and J. P. Casey, St. Louis. At the afternoon meeting these officers were elected for the following year: President, P. A. Bertrand, Jefferson City; vice-presidents, J. E. Harsh, Joplin; C. L. Clary, Sikeston, and A. C. Einstein, St. Louis; secretary-treasurer, P. W. Markham, Brookfield. The new executive committee is composed of Messrs. Bertrand, F. E. Murray, Louisiana;

J. M. Scott, Kansas City; C. C. Barnard, Lexington; J. P. Woodfill, Aurora, and Hugo Wurdack, St. Louis. On invitation of Mr. S. J. Duncan, the association voted to hold its 1913 convention at Mexico, Mo.

Mr. P. A. Bertrand, the newly elected president of the Missouri association, is general manager of the Jefferson City Light & Power Company, in which capacity he has acted since 1906. Three years prior to that time he was manager of the Springfield (Mo.) Gas & Electric Company, and from the date of his graduation in 1895 from the University of Wisconsin until 1903 was connected with the Peoria (Ill.) Gas & Electric Company. Mr. Bertrand is a member of the American Gas Institute and the National Electric Light Association.

The total registration of the Joplin meeting reached nearly 150. Among the entertainment features enjoyed by the delegates as the guests of the local utilities were automobile trips through the mining districts, a visit by special train to the Riverton (Kan.) turbine plant of the Empire District Electric Company, and a trolley trip around the mine country followed by a luncheon as the guests of the Southwest Missouri Electric Railway. On Friday evening there was a banquet at the Hotel Conner, during which Toastmaster N. Paige called upon Messrs. D. D. Hoag, Clark Craycroft, Richard Crahan and George Hayler, all of Joplin; F. E. Murray, Louisiana; Stuart Tritle, Kansas City; N. Roth, Chicago, and S. Bronson, Ozark. At a rejuvenation of the Sons of Jove on Thursday evening eighteen new members were initiated into the order under the direction of Third Jupiter Samuel A. Hobson.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION, FIRST DISTRICT.

Important steps were taken during the week toward the carrying out of the dual plan of subway extensions adopted by the commission and approved by the transit committee of the Board of Estimate and Apportionment. Governor Dix signed the Wagner bill, amending the rapid transit act so as to permit the city authorities to enter into contracts with the Interborough Rapid Transit Company and the Brooklyn Rapid Transit Company for the equipment and operation of the proposed lines. Following this action by the Governor, the commission instructed its counsel to prepare forms for the proposed contracts with these companies embodying the terms for construction, equipment and operation submitted by the companies in their respective propositions. After these forms are prepared they will be submitted for discussion at a public hearing, after which they will be put in permanent form for approval by the commission and the Board of Estimate and Apportionment. These operating contracts will cover the Broadway-Lexington Avenue subway in Manhattan and the Bronx, now under construction; the Brooklyn loop subway in Manhattan and the Fourth Avenue subway in Brooklyn, which are nearly completed; the extension of the existing subway from Times Square south through Seventh Avenue and other streets to the Battery and thence by tunnel to Brooklyn; the proposed Broadway subway for the Brooklyn Rapid Transit Company with a new tunnel to Brooklyn, and the various branches of both systems in the Bronx, Brooklyn and Queens. Counsel was also directed to embody in such contracts provisions for the immediate operation of the Steinway Tunnel connecting Forty-second Street, Manhattan, with Long Island City and for the immediate operation of other lines as soon as they are completed.

After investigation and public hearings, the commission has issued an order to the Bridge Operating Company directing it to reduce the fare now charged for local service over the Williamsburg Bridge to 2 cents for a single fare and three tickets for 5 cents. At present the company is charging 3 cents for a single fare or two tickets for 5 cents under a contract made with the city through the Bridge Commissioner in 1904 which allows such rates. The commission holds that this contract does not affect the power of the commission to reduce rates when found unreasonable. It finds that the Bridge Operating Company, which has a capital stock of $100,000, has been making profits of about 112 per cent from this local bridge service for the last two years. The Bridge Operating Company was formed by the New York City Railway Company, then operating the Metropolitan Street Railway System in Manhattan, and by the Brooklyn Rapid Transit Company, each subscribing for one-half of the capital stock. Under subsequent agreement, the Brooklyn Heights Company, a subsidiary of the Brooklyn Rapid Transit Company, is performing the local service for which the Bridge Operating Company was formed. The order reducing the fare goes into effect April 22, but the company has not yet indicated whether it will accept the order.

The commission received during the week the report of the Bureau of Gas and Electricity on the number of gas and electric meters tested during the month of March. It shows that 34,978 gas meters and 120 electric meters were tested during the month. Of the gas meters, 421 were tested upon complaint, and of this number 191, or 45.4 per cent, were found fast, 44, or 10.5 per cent, slow, and 186, or 44.1 per cent, within the limits allowed by law, namely, between 2 per cent fast and 2 per cent slow. The 120 electric meters were all tested upon complaint, and 107, or 89.2 per cent, were found to be within the limits of accuracy allowed by law, namely, between 4 per cent fast and 4 per cent slow. Only six, or 5 per cent, were found fast and seven, or 5.8 per cent, slow.

NEW YORK COMMISSION, SECOND DISTRICT.

The commission has received a petition signed by over 200 residents of Syracuse asking that the Syracuse Rapid Transit Railroad Company be required to furnish adequate trolley car service to the main entrance of the stadium on the campus of the Syracuse University, near the corner of Irving Avenue and Croton Street, and also to the residents of Raynor Tract in the same neighborhood.

It is stated that the cars on this line run to a point about 250 yd. from the small side entrance to the stadium and 370 yd. from the main entrance, and that because of single track, grade and lack of power only two cars every eight minutes can be run on this line, or less than 1500 persons in an hour can be carried, whereas the attendance at events held in the stadium is from 400 to 11,000 persons, the average attendance being over 1200. It is also stated that there is a large and rapidly growing population in this immediate vicinity, and these residents have to walk from a quarter to a half mile to reach the nearest car line.

The commission has received from the Albany Southern Railroad Company a petition asking permission to begin construction and exercise rights and privileges under a franchise granted by the municipal authorities of the town of Greenport, Columbia County. The company is now furnishing electricity to the cities of Hudson and Rensselaer and to intermediate villages and desires to furnish electricity for public and private use in the town of Greenport.

An informal complaint received from the Postal Telegraph Cable Company against the New York Telephone Company alleges that the latter company is wrongfully and by illegal discrimination diverting to the Western Union Telegraph Company telegrams which are intended for the Postal Telegraph Cable Company. A large number of instances occurring at New York, Rochester, Poughkeepsie, Schenectady, Ithaca, Brooklyn, North Tonawanda, Albany and Gloversville are given.

Superintendent Kimmey, of the Postal Telegraph company, points out that the matter was called to the attention of the New York Telephone Company on Feb. 13, and President Bethel, of the New York Telephone Company,

replied on March 1 that it was not the intention of his company to permit any difference in treatment between calls for Postal offices and calls for Western Union offices, and that every effort had been made to avoid any discrimination in this respect, but notwithstanding this the objectionable practice continues. The commission is asked to direct the telephone company to discontinue this practice and to instruct its operators that when a person on the telephone wishes to send a telegram the operator shall ask which telegraph company is desired.

The application of the Oswego River Power Transmission Company for permission to furnish electrical energy for light, heat and motor service in the city of Fulton, Oswego County, has been refused. Before denying the application of the new company, which proposed to bring energy from Niagara into Fulton, the commission required the company now serving that city, the Fulton Light, Heat & Power Company, to agree to a reduction in the price of arc lamps for street lighting from $75 to $65 per year for a period of five years, unless the price be increased with the authority or consent of the Common Council or the Mayor, or through legally constituted authorities of the city of Fulton, or with the consent of the commission.

The Fulton Light, Heat & Power Company has also agreed that on and after May 1, 1912, it will offer for sale and undertake to sell to all applicants electricity for industrial purposes in the city of Fulton upon the same terms as to price and under the same or equivalent conditions as to service that are afforded by the company which proposed to compete in that city.

The commission has authorized the Southern New York Power Company, doing business at Walton, Delaware County, to issue its common capital stock of the par value of $11,700, the proceeds to be used in payment for equipment and construction in connection with its plant.

The commission has authorized the Northville Electric Light & Power Company to sell its plant in the village of Northville, town of Northampton, Fulton County, to the Broadalbin Electric Light & Power Company for the sum of $8,000.

Application has been received from the Mountain Home Telephone Company of Saranac Lake asking authorization for an issue of $633,000 par value of additional capital stock and approval of a new general mortgage to secure a maximum issue of $2,000,000 par value of 5 per cent bonds, the present issue to be $1,004,200. Approval is also asked for the transfer to the Mountain Home Company of local franchises now held by the Adirondacks Home Telephone Company and the New York Telephone Company.

MASSACHUSETTS COMMISSION.

The Worcester Suburban Electric Company has filed a petition with the Massachusetts Gas and Electric Light Commission asking for authority to issue additional stock of the par value of $200,000 to meet the cost of improvements made and under contemplation for the near future. The company recently petitioned the board for authority to issue new stock to the amount of $100,000 par value, and states that it has since learned that the proposed total issue will be needed to finance new developments as planned. The commission has therefore been requested to consider the two petitions as one. The directors have fixed the price of the stock at $100 per share.

The Easthampton Gas Company has petitioned for the right to issue new stock to the amount of $100,000, to defray the cost of improvements, and the commission has approved the issue by the Cambridge Gas Light Company of new stock to the amount of $240,000 par value, at a price of $200 per share as fixed by the directors, 2400 shares being authorized. The proceeds will be used in meeting the cost of plant improvements.

Hearings have been concluded by the commission upon the petition of various consumers for a reduction in the rates charged by the Edison Electric Illuminating Company of Brockton. At the final hearing the company presented much interesting testimony in connection with its administration and finances. Mr. A. Stuart Pratt, of the Stone & Webster Management Association, of Boston, pointed out that, like many other central stations in New England, the Brockton organization had only lately attained a reasonably prosperous basis of operation. The company started thirty years ago, with an Edison three-wire system, and paid little or no dividend for years. In 1907 the growth of the business necessitated the building of a large steam-turbine station at East Bridgewater, where coal and water supplies were favorably obtained and land was cheap. An extensive distribution system was established and energy sold to surrounding central-stations in the interests of economical operation and reduced prices to the consumer. This expansion was secured at a heavy cost, and the average return on the investment for the past ten years has been about 5.7 per cent. Mr. Pratt stated that since the East Bridgewater plant was established the maximum net price has been reduced from 18 to 15 cents per kw-hr., and the demand charge has been cut down from fifty hours' use of the connected load at the high rate to thirty hours' use. The number of customers connected increased by 483, or 18 per cent, in the fiscal year 1911. He contended that differential rates are necessary in the central-station industry and urged that the increase of business secured is a strong indication that the company's rates are reasonable. Regarding the power contract in force between the Brockton and the Abington companies, both controlled by Stone & Webster, he pointed out that the communities were both benefited by the continuation of the plan of purchasing energy from the Brockton system.

Testimony regarding the rate situation at Brockton was presented by Mr. N. T. Wilcox, in answer to criticisms of the petitioners. He stated that in installations where the cost of a demand indicator is not warranted the company bases its primary charge upon the connected load at the time the contract is made. This is adjusted from time to time at the request of the consumer or in connection with meter tests. Taking up different classes of service, Mr. Wilcox said that residence lighting involves about double the investment in distribution systems that ordinary commercial lighting requires, resulting in high fixed charges per unit of capacity required. In the power field the use of large transformers, reduced loss in percentage of total energy delivered and distribution of fixed charges over eight or ten hours' daily use enabled a lower price to be given to meet competitive commercial conditions. Investigation in the street-lighting field shows that, on the basis of tungsten-lamp service, the total station and distributing investment per kilowatt of capacity may run from $1,200 to $2,400, a fact which Mr. Wilcox considered should support a relatively high rate per kw-hr. Mr. Wilcox contended that the average use of energy for lighting service in an ordinary office is not large enough to enable the consumer to obtain the secondary rate of 9 cents net, with few exceptions. The Brockton rate is 15 cents per kw-hr. for the first thirty hours' use per month of the connected load, and the secondary rate is 9 cents. The installation of demand indicators is left largely to the judgment of the solicitor. The company would not install such an indicator on less than 2 kw or 3 kw of connected load. Commissioner Schaff expressed the opinion that the advocates of differential rates are certain to become fewer as time passes, and urged the importance of endeavoring to establish uniform rates.

OHIO COMMISSION.

At a recent hearing on the complaint that the Cincinnati & Suburban Bell Telephone Company will not consent to physical connection with the lines of the Independent company at Hamilton, evidence was introduced to show that the Bell company has succeeded so far in preventing the

Independent companies from entering Cincinnati with their toll lines and that refusal in this case is for the same purpose. A controversy centered around the wording of a clause in the public utilities law which says the commission may enforce connection between two telephone exchanges in order to serve points not reached by either of them. The Bell company's attorneys contend that under this clause the commission cannot order connection, but the Independent company contends that this is a careless wording of the clause and that the Legislature intended to mean points reached by one and not the other. The Bell company brought in evidence to show that such a connection would be detrimental to its business, while the other side sought to prove that the Bell company took little pains to give good service and refused to extend its lines unless a sufficient number of subscribers came forward to make it profitable. It is probable that the commission will not be able to render a decision for some time and that the matter will be carried through the courts, no matter which side wins.

James A. Robinson has filed a complaint with the commission to the effect that the Northern Ohio Traction & Light Company does not operate a sufficient number of cars on its local lines at Canton to take care of the traffic and that the cars are small and unsafe.

The Columbus, Kenton & Toledo Traction Company, of Kenton, has filed a request for authority to issue $50,000 stock and $1,375,000 bonds, from the proceeds of which it expects to build a line between Columbus and Findlay.

The Sycamore Telephone Company has filed a petition with the commission asking that its case be reopened. Some time ago application was made by a partnership owning the property for authority to incorporate with a capital stock of $60,000, of which $50,000 was to be paid for the property. The commission took the view that the stock issue was excessive and withheld authority. The new petition alleges that the commission ruled incorrectly.

The application of the Trumbull Public Service Company, of Warren, to issue $164,000 bonds, to be sold at 92 and the proceeds used to take up notes amounting to $150,000, has been refused on the ground that this would increase the capital investment without adding to the value of the property.

MARYLAND COMMISSION.

The recent appeal of the Western Union Telegraph Company from an order of the commission directing it to re-establish its abandoned office in the Belvedere Hotel, Baltimore, has been amicably settled by the capitulation of the telegraph company and its consent to re-establish the office as directed. The outcome of this case strengthens the contention that the commission has the right to compel a telegraph company to establish an office at any designated place in order to serve the public adequately.

At further hearings on the complaint of the Patapsco Electric & Manufacturing Company against the Consolidated Gas, Electric Light & Power Company, Vice-president Wagner of the Consolidated company testified that it is selling energy to the Baltimore & Ohio Railroad Company and to the Maryland Electric Railways Company for 1 cent per kw-hr. and furthermore is selling energy to the Baltimore Copper Smelting & Refining Company, of Canton, for ½ cent per kw-hr. At the opening of the hearing Mr. Wagner contended that the evidence should be confined to the charge of conspiracy brought by the Patapsco company, but this was overruled by Commissioner Hering, who stated that the commission desired to hear evidence on all phases of the complaint. In explaining the unusually low rate to the refining company, Mr. Wagner stated that it consumed energy twenty-four hours per day every day in the year, and that for this service it pays a gross sum of about $125,000 per annum.

Officials of the Chesapeake & Potomac Telephone Company admitted last week before the commission that they were not following the provision of Schedule E of the business rate, respecting the purchase of excess calls in blocks of 900 at $18. This schedule is intended for large users of telephone service. The minimum number of calls is 8400 annually, at 2 cents each, or $168. Excess calls may be had at 3 cents each, or, if taken in blocks of 900, at 2 cents each, or at $18 a block. The company's representatives said that they had in mind, when the schedules were made, that contracts for blocks of 900 at $18 would have to be made when the contract was signed. The general understanding has been, however, that arrangement for these blocks might be made at any time within the contract year, according to the necessities of the subscriber, and this was the intention of the commission. Representatives of the company also met the commission in conference to consider some of the complaints which have arisen from the company's interpretation and application of the new rate schedules. Chairman Laird and Secretary Duvall of the commission took an aggressive attitude and at times the conference became spirited. It was determined finally that the officials shall prepare statistics regarding the business done under certain schedules causing trouble, and report to the commission later.

In an order issued last week the question of the operation of the cars of the United Railways & Electric Company to Howard Park, Woodlawn and West Arlington was settled by requiring the company to operate the cars of the West Forest Park branch through Woodlawn via Garrison Avenue and to terminate its West Arlington branch at Gwynn Oak Junction. This order was issued after the commission had required an accurate record to be kept of the traffic on these lines passing through Gwynn Oak Junction, which showed that 70 per cent of the patrons used the West Forest Park branch.

The commission has granted the petition of the Frederick & Hagerstown Power Company asking for authority to exercise its franchise and charter rights. This includes an issue of $300,000 par value of first-mortgage ten-year 6 per cent gold bonds, secured by a trust deed held by the Baltimore Trust Company as trustee. The construction of the power plant in accordance with plans and specifications filed with the commission is also authorized, the work to be done by Oscar B. Coblentz, contractor, in payment for which he is to receive the issue of common stock.

Current News and Notes

New Type of Storage Battery.—According to a cable dispatch, Prof. H. I. Hannover, of the Stockholm Polytechnical High School, has invented a storage battery which is claimed to reduce largely the weight of this apparatus for a given service. The invention is stated to consist in producing "a lead metal containing millions of holes or cavities so minute as to be invisible except through powerful microscopes."

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Proposed Utilities Inquiry.—An investigation to determine the extent to which regulation of public-utility companies may be carried without unduly interfering with their management will be conducted by the National Civic Federation, under the direction of Dr. John H. Gray, professor of economics at the University of Minnesota, who has made a number of special investigations for the United States Bureau of Labor. The investigation will cover telephones, steam and electric railroads, water, gas, electric and water-power companies. A complete compilation of all the public service laws of the United States (both federal and state), Great Britain and the Dominion of Canada is now in progress.

KENTUCKY PUBLIC SERVICE COMMISSION.—There is a well-defined report that Governor McCreary will call an extra session of the State Legislature for the purpose of passing a bill creating a public service commission. A similar measure was defeated at the legislative session which closed last March.

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PHOTOGRAPHS OF BOOK PAGES.—The John Crerar Library, Chicago, has installed a special photographic outfit for making reproductions of pages of books, rare and otherwise, prints of two facing pages being supplied for 10 cents. The library has an excellent electrical collection, including electrical periodicals, and this photographic service may therefore be occasionally of value to some of our readers.

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GIANT POWER STATION IN BRAZIL.—It is reported that the government at Brazil has granted a concession to Valle, Rodrigue & Romos, of London, and Bromberk, Hacker & Company, of Rio de Janeiro, for the development of the water-power of Paulo Affonso Falls on the San Francisco River. The concession is for a period of seventy years, and it is required that an initial plant of 200,000 hp shall be installed, to be increased to 1,300,000 hp fifteen years after the primary installation.

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CLARINDA AND CORNING, IA., TO BE ELECTRICALLY CONNECTED.—On April 8 the Lee Electric Light Company, of Clarinda, Ia., of which Mr. Rufus E. Lee is manager, entered into a contract for the purchase of the Corning Light, Heat & Power Company, of Corning, Ia., which will be taken over on May 1. The Lee company expects to sell the present station equipment in Corning and supply electrical energy to that place from Clarinda by way of the village of Gravity. This will require a three-phase transmission line 34 miles long. Corning is the county seat of Adams County.

* * *

EXTENSIONS IN SAN DIEGO.—With the remarkable growth of the city of San Diego, Cal., the San Diego Consolidated Gas & Electric Company, which is controlled by H. M. Byllesby & Company, of Chicago, is experiencing a greatly increased demand for electrical energy. The power house is being reconstructed, and it seems difficult to keep pace with the demand for electricity. The company has just ordered a 5000-kva, three-phase, 60-cycle, 2300-volt horizontal Curtis turbo-generator from the General Electric Company. This large unit will probably be in service before the year is out.

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KENTUCKY FRANCHISE ASSESSMENTS.—The Kentucky State Board of Valuations and Assessments, sitting at Frankfort, has instituted a general increase in the franchise assessments of public service corporations, including electric companies, traction lines, etc. The statement was made during the recent legislative session that the public service companies were not being fully assessed, and the state board, acting on this basis, is making general and arbitrary increases, the raises thus far made totaling $137,000,000. One of the companies included is the Covington Lighting Company, the assessment on which has been raised from $844,200 to $3,350,000.

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HYDROELECTRIC DEVELOPMENT IN THE UNITED STATES.—The recent report to Congress of the United States Commissioner of Corporations on "Water-Power Development in the United States" has been issued as a volume of 220 pages, and is of particular interest owing to the details given as to hydroelectric development. The book consists of three sections, as follows: Physical conditions and economic aspects of water-power; concentration of ownership and control; water-power and the public. A series of charts gives the location of the larger hydroelectric plants and shows their transmission lines. The principal object of the report is to bring out the present ownership or control of the hydroelectric systems.

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FAKE DAMAGE SUITS.—Following the trial of five damage actions against the Toronto Street Railway Company in which disclosures were made by witnesses showing that the officials of the company had employed detectives to bring "fake" damage actions against the company for the purpose of trapping several Toronto doctors, the grand jury has returned a true bill, containing five counts, against the general manager, claim agent and counsel of the company and two detectives, charging them with unlawfully conspiring together to obstruct, pervert or defeat the course of justice, with criminal fabrication of evidence and with bringing a court of justice into contempt. The case will probably be heard at the May criminal session.

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ELECTRIC CLUB OF CHICAGO AND THE SONS OF JOVE.—At the meeting of the Electric Club of Chicago on April 11 the action taken on April 4 in voting from the club's treasury a sum not to exceed $500 to assist the Sons of Jove in Chicago to promote a forthcoming rejuvenation, with the idea of increasing the Chicago membership of Jovians, was reconsidered. The resolution was adopted originally at a slimly attended meeting by a vote of eighteen to eight, out of a total membership of about 325. At the meeting of April 11, after the original resolution had been reconsidered, it was voted to lay the subject on the table until a letter or post card could be sent to each member in good standing asking for an expression of opinion on the advisability of making the appropriation. This action was taken after a lively discussion, in which keen interest was manifested.

* * *

BOSTON ELECTRIC VEHICLE CLUB MEETING.—At a meeting of the Boston Electric Vehicle Club held on April 10 Mayor Fitzgerald was the first speaker. He stated that the demands for smoother pavements are intrinsically good arguments for the use of motor vehicles in place of horses. He promised to do all in his power to improve the paving conditions in Boston. Other speakers were Mr. Parker H. Kemble, of the Toronto (Ont.) Electric Light Company; Messrs. R. W. Rollins and Fred H. Smith, of the Worcester (Mass.) Electric Light Company; Mr. P. M. Patterson, of the Westinghouse Electric & Manufacturing Company, Boston; Mr. M. J. Fitch, of the General Electric Company, Lynn, Mass., and Mr. W. P. Kennedy, New York. Mr. Parker stated that two dealers in Toronto have sold twenty-eight new electric automobiles since Christmas. Four new public garages are under way with accommodation for 140 cars at this time and ultimately for 400 cars, and the largest department store in the city has become interested in electric vehicles.

* * *

CHINESE TELEPHONE STUDENTS.—During the early part of 1911 the authorities of the Government Technical College at Shanghai, or the Nan Yang University, arranged with the Western Electric Company for sending a number of the members of the graduating class in electrical engineering to the United States for training in that company's shops, and in July, 1911, three graduates, the first ever sent out by the university for such training, left for America to enter the Hawthorne plant of the Western Electric Company at Chicago to engage in the practical study of telephony in the company's student course. Following this, they will spend some time with one of the large operating telephone companies. Upon completion of their studies, it is expected that the men will be of material

assistance in promoting and developing the telephone system of China. The men, whose names are Chu Fu I, Long Kuo Tsan and Sung Pao Kien, are proving themselves well adapted to their future vocation and will in all likelihood be heard from again in later years when the telephone has gained a greater hold in China.

* * *

Postal Underground Railways in London.—A committee appointed by the Postmaster-General to consider the question of the transmission of mails in London by pneumatic tube or electric railway has recommended electric railways in tubes 7½ ft. in diameter and accommodating two tracks of 2-ft. gage. It favors motor cars over locomotives and trailers, designed for a speed of about 35 miles an hour. A preliminary line 6½ miles long is proposed at a cost of $2,565,000.

* * *

The Institute of Operating Engineers.—In an address before the Institute of Operating Engineers in New York on April 2 Mr. H. G. Stott stated that electricity is now being used for cooking at the employees' lunch station of the Interborough Rapid Transit Company instead of gas, which was employed formerly. He claimed that the cost has been reduced by 50 per cent, attributable in part to the fact that the electrical devices consume energy only when in use, while the gas flame is apt to be kept burning when not needed. The next meeting of the Institute will be held on April 25 in the Engineering Societies Building, New York.

* * *

New York Jovian Luncheon.—Mr. John F. Gilchrist, president of the National Electric Light Association, was the guest of honor and principal speaker at the regular semi-monthly luncheon of the New York Sons of Jove, held at Kalil's Restaurant on April 17. President Gilchrist chose for his topic "Public Service," and during his remarks, which were listened to with great interest, he dwelt upon the important and fundamental position of the central station as the probable ultimate source of electrical energy for all lighting and power purposes. He warmly commended the co-operative work of the Jovian members and attributed much of the successful and rapid development of the electrical industry during the past few years to their efforts.

* * *

New England N. E. L. A. Activity.—At a meeting of the New England Section of the National Electric Light Association at Boston on April 12 Mr. Carl T. Keller delivered an address upon corporate and individual responsibilities. It was announced that a plan is under consideration for broadening the work of the present Boston Edison company section of the N. E. L. A. through a possible change of name and functions to include all members of the national body in the Greater Boston field. A meeting of the section was scheduled for April 16, the program including a paper on the synchronous booster converter by Mr. E. T. Dillon, of the Westinghouse Electric & Manufacturing Company, and an illustrated lecture on the Pacific Northwest by Mr. W. H. Blood, Jr., of Stone & Webster.

* * *

Steaming Tests of Coal.—The Bureau of Mines of the Department of the Interior has just published a new bulletin entitled "Steaming Tests of Coals and Related Investigations," by Messrs. L. P. Breckenridge, Henry Kreisinger and Walter T. Ray. This publication covers the work done in fuel testing under government direction during the period from Sept. 1, 1904, to Dec. 31, 1908. The bulletin is very comprehensive and embraces 370 pages. It contains some data previously published in bulletins of the Geological Survey, but for the first time brings together in a single publication a summary of all the investigations completed down to the date of compilation. The bulletin is divided into parts one and two. The first part contains a description with complete final data of steaming tests, and the second part contains a study and discussion of the results obtained.

* * *

SOCIETY MEETINGS.

Oklahoma Electrical Convention.—The first convention of the Gas, Electric and Street Railway Association of Oklahoma will be held in Oklahoma City on May 22 and 23. The two days will be devoted to four meetings, for the conducting of business and presentation of papers. The meetings will probably be held in the convention halls of the Oklahoma State Fair Association. The president of the association is Mr. N. R. Gascho, Alva, and the secretary is Mr. H. V. Bozell, Norman, Okla.

* * *

International Congress of Applied Chemistry.—Among the papers to be presented at the eighth International Congress of Applied Chemistry, to be held in Washington and New York from Sept. 4 to 13, 1912, are the following which are of particular interest to our readers: *A Controlling Device for Electric Furnaces,* by Dr. C. P. Thwing, of Philadelphia; *The Thermal Ohm, a New Unit of Thermal Resistance,* by Dr. Carl Hering, Philadelphia; *New Applications of Ductile Tungsten and Molybdenum,* by Dr. E. G. Fink, Harrison, N. J.; *Recent Developments in the Electric Steel Furnace,* by Dr. P. Heroult, New York.

* * *

Southwestern Electrical Association Convention.—Among the papers to be presented at the eighth annual convention of the Southwestern Electrical and Gas Association at San Antonio, Tex., April 25, 26 and 27, will be the following: *Theft of Electric Energy and Gas,* by Mr. Harold L. *Geisse,* of the San Antonio Gas & Electric Company; *Public Service Corporations and State Development,* by Hon. Louis J. Wortham, Fort Worth, Tex.; *Advantages and Disadvantages of Prepaid Meters,* by Mr. George M. Griffith, of the Galveston Gas Company; *The Relation of Power-Factor to Central-Station Costs,* by Mr. Frank M. White, of the Amarillo (Tex.) Water, Light & Power Company; *The Distribution of Electricity from Central Stations,* by Mr. A. D. Brinkerhoff, of the Waco (Tex.) Electric & Gas Company; *Relations Between the Public and Public Service Corporations,* by Mr. E. W. Kellogg, Jr., of the El Paso (Tex.) Electric Street Railway Company. The secretary of the association is Mr. Dan G. Fisher, 3419 Hall Street, Dallas, Tex.

* * *

Michigan Convention Cruise.—In arranging for the 1912 convention the officers of the Michigan Electric Association, as previously announced, have chartered the steamship *Majestic,* of the Northern Navigation Company of Canada, and the convention will be held on board ship. The itinerary is as follows: Leave Port Huron, Mich., 1 p. m. Friday, June 21 (Central time); arrive Penetang 1 p. m. June 22 (Eastern time); leave Penetang 2 p. m. June 22; arrive Parry Sound 8 p. m. June 22; leave Parry Sound 11 p. m. June 22; arrive Sault Ste. Marie 9 p. m June 23; leave Sault Ste. Marie 12 midnight June 23; arrive Mackinac Island 8 a. m. June 24 (Central time); leave Mackinac Island 3 p. m. June 24; arrive Port Huron 3 p. m. June 25. The cost of the proposed trip is $30, and the secretary, Mr. Herbert Silvester, 18 Washington Boulevard, Detroit, will be pleased to give further details to those who wish to attend. It is urged that early arrangements be made by those desiring to be present. Official announcement is made that the Michigan Electric Association has become the Michigan Section of the National Electric Light Association, by which name it will be known hereafter.

HIGHEST-VOLTAGE TRANSMISSION SYSTEM IN THE WORLD—II.

The Au Sable Electric Company, Supplying Electrical Energy to Bay City, Saginaw and Flint, Michigan.

Hydraulic Features and Construction Details of Cooke Water-Power Plant—Operating Characteristics of 140,000 Volts—Substations with Specially Designed Apparatus.

THE first instalment of this article, printed last week, gave a general description of the transmission system of the Au Sable Electric Company and details of hydroelectric equipment, 140,000-volt transformers, high-tension wall inlets, lightning arresters and tower-line construction. The present instalment, which concludes the article, deals with other construction and operating details.

ZILWAUKEE SUBSTATION.

Eighty-five miles from the Cooke water-power plant is the Zilwaukee 140,000-volt substation, located about midway between Bay City and Saginaw, into each of which it delivers 11,000 and 22,000-volt energy. As shown in the exterior view of the Zilwaukee substation (Fig. 1), the 140,000-volt line (which extends southward to Flint) is looped through the substation buses from which is taken the supply for the three 3000-kw Zilwaukee transformers. Three sets of high-tension oil switches, like those at Cooke, are provided here, for the incoming and outgoing lines and station transformers respectively.

This interesting substation at Zilwaukee is a concrete foundationed structure, 88 ft. by 49 ft. in plan, with red brick walls and green tile roof. The Cooke line, coming in through the north entries, is led through a set of 140,000-volt oil switches and thence to the substation 140,000-volt buses, made of 1.25-in. iron pipe suspended on line insulators. The group of oil switches for the Flint line and for the Zilwaukee transformers are interspersed at 5½-ft. centers, or 11 ft. between elements of the same group. These non-automatic switches are similarly hand-operated from lever panels, and the construction of bus connections, etc., is in general similar to that already described at Cooke.

The three 3000-kw Zilwaukee transformers have 140,000-volt delta-connected primaries and secondary windings comprising a 2750-kw, 22,000-volt coil, with 50 per cent or

Fig. 10—140,000-Volt Entries at Zilwaukee Substation.

11,000-volt taps, and two 125-kw, 370-volt secondaries for rotary-converter supply. The 300-kw, 500-volt railway rotary seen in Fig. 11 affords an interesting comparison of the hugeness of the 140,000-volt oil switches and transformers.

From the transformer secondaries the 22,000-volt and 11,000-volt lines are carried through a casting-covered floor trench to the oil-switch and busbar room behind the switchboard seen in Fig. 12. Here are located the oil switches controlling the circuits leading to Saginaw and Bay City, the instrument transformers and the 22,000-volt and 11,000-volt aluminum-cell lightning arresters. The sim-

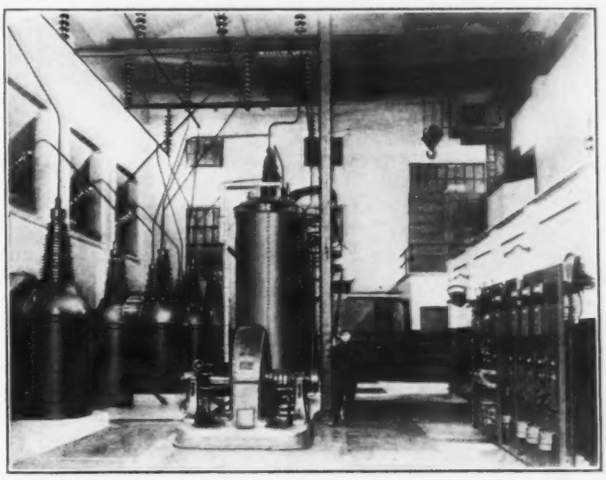


Fig. 11—Interior of Substation, Showing 140,000-Volt Switches and Transformers and 300-kw Rotary Converter.

ple and compact construction of all this 22,000-volt apparatus is no less interesting than the more spectacular equipment on the opposite side of the station. As might be expected in a 140,000-volt system, pressures of 22,000 to 11,000 volts are treated something like "low tension," and the greatest simplicity consistent with completeness is dis-

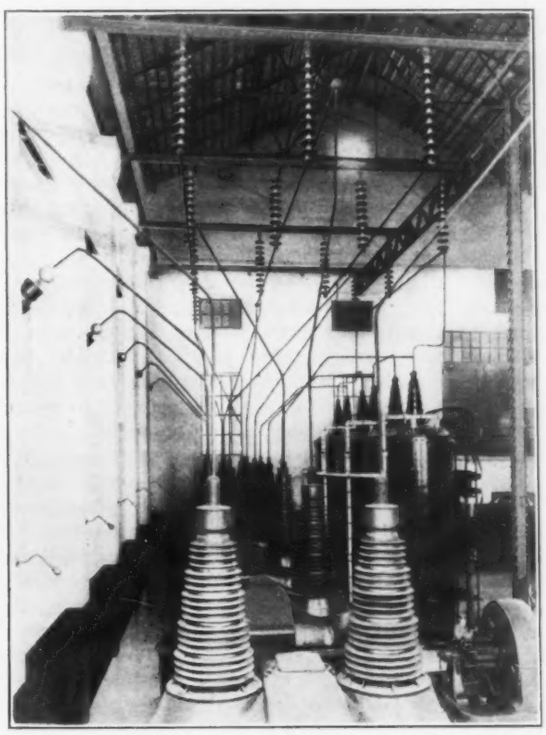


Fig. 12—140,000-Volt Bus Construction in Substation.

played in the selection and disposal of this distributing-line apparatus. The secondary lines leave the substation on the side opposite the 140,000-volt entries and are carried on separate tower lines with three disk suspension insulators into their Bay City and Saginaw terminals.

FLINT STEAM RELAY STATION.

At the Flint steam-turbine plant, 40 miles from Zilwaukee and 125 miles from Cooke, is the present terminus of the 140,000-volt line. The 30-mile link to Owosso (see map, Fig. 2) is, however, now nearly completed, while from Owosso to Lansing and Charlotte a 50-mile section of eight-disk insulator line has been erected two years and is

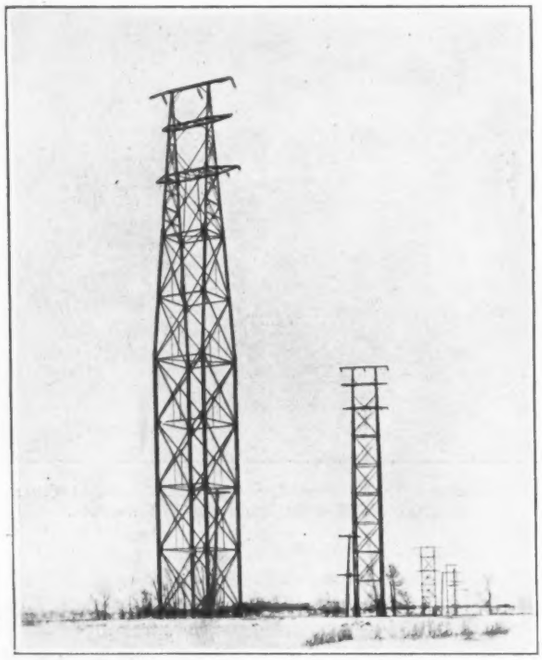


Fig. 13—140,000-Volt Line Crossing Saginaw River on 167-ft. Towers.

at present in use on the 40,000-volt system. While now a terminal substation, Flint will thus later become a switching point like Zilwaukee. For 2 miles before entering the Flint station the Zilwaukee and Owosso lines share a double tower line, at the end of which will be built a switch house adjoining the Flint plant.

A large industrial load, including several automobile factories, is supplied at Flint, for which purpose the present steam-turbine station was hastily built two years ago, pending the arrival of Au Sable hydroelectric energy. This modern steam plant contains six 600-hp Stirling boilers and one vertical and one horizontal 3000-kw Curtis-General Electric turbo-generator set. The 140,000-volt oil switches and transformers are installed at the north end of the turbine room. The high-tension entries here differ from those at Cooke and Zilwaukee in having the insulators set vertical in a horizontal shelf which forms the ceiling of a niche chamber, 30 ft. by 25 ft. and 12 ft. deep, in the building wall. The oil switches are spaced at 8-ft. intervals and the transformers at 9-ft. centers. At Flint the three 3000-kw transformer units have 22,000-volt, 5560-volt and 370-volt secondaries and are arranged for oil draining and continuous filtration in the way already described.

The Flint turbine station thus becomes the steam relay plant for the 140,000-volt system and, in case of any interruption to service from the Cooke water-power, can be called upon to transmit back through the line to Bay City and Saginaw as well as to serve the cities along the new extension. The substation at Owosso was originally erected for 140,000-volt operation and is installed complete ready for service at that pressure as soon as the link from Flint is completed.

OPERATING CHARACTERISTICS AT 140,000 VOLTS.

From the day the full tension was first impressed on the Cooke transmission line its operation has been so wholly uneventful that the men in charge of the stations declare they notice no difference between operating at 140,000 volts and 40,000 volts. The utmost care had been exercised in erection and preparation and every contingency was so fully anticipated that on starting up the system everything worked exactly as planned.

As is customary when putting pressure for the first time on any new high-voltage line, both the charging kilovolt-amperes and the energy consumed by the unloaded line were rather large during the first half hour, but stable conditions soon followed and the apparent power taken to charge the line then fell off to about 80 kva per mile. The No. 0 conductors of this line, it must be remembered, are operated very near to their critical corona point, 142,000 volts. With 140,000 volts on the generator and the Flint transformers connected but not loaded, pressures 17 per cent higher, or nearly 164,000 volts, are read at Flint, due to the capacity reactance of the line. With the receiving transformer primaries disconnected, the end voltage of the open line probably rises to 190,000 volts, although no measurements have been taken. Of course, the excessive rise above the corona point in the distant sections causes leakage losses in those portions which may run quite high. With receiving transformers disconnected, the open line is found to consume or leak about 3000 actual kw, dissipated as corona loss in the distant sections when the voltage is high. With additions of load at the receiving end the line current remains practically the same or even diminishes, depending on the inductive character of the demand, while the power factor, of course, rises. With a 4000-kw 65 per cent lagging inductive load at Flint, the power-factor at the generators has been observed to be 85 per cent leading. With accession of further inductive load and the completion of the Owosso link, it is expected to be possible to move the point of unity power-factor back to the generating station. No tests have thus far been made on the corona power loss of the line running at normal 140,000-volt pressure, but this loss is believed to amount to about 3 kw per mile. The transmission is designed to convey about 25,000 kw, and as the point of economic loading is approached its condensive reaction will be offset, a more uniform voltage maintained from end to end, and its efficiency increased. Like any large piece of apparatus, a 140,000-volt line must be operated within the magnitude of its capabilities.

Experience at Au Sable proves at any rate that transmission at 140,000 volts is a practical and economical procedure, but it should be made clear that such a pressure is justified only where the distance and the quantity of power to be transmitted are such that conductors of sufficient sec-

Fig. 14—General View of Cooke Plant, Showing Sluiceway and Pipe Line for Making Earth-Wall Fill.

tion to prevent corona are economically used. While it has been suggested that hemp-center cables might provide increased cylindrical areas and so raise the corona limit or decrease the copper investment necessary with a desired high voltage, the fact remains, according to the experience

of the Au Sable Electric Company's engineers, that such hemp-center cables show a higher corona loss than equivalent all-copper conductors. This is attributed to the hemp fibers extending out through the cable strands and to the little nodules formed by the pitch used to lubricate the strands, both of which provide discharge points for the occurrence of corona loss.

CONSTRUCTION OF COOKE PLANT.

Many of the construction methods employed during the building of the Cooke water-power plant were novel and interesting. Direct-current and alternating-current motors were used for every possible operation. The river formerly flowed in a bed now occupied by the power house. While the concrete structures were being built the stream was diverted through a new channel under the trestlework marking the future core wall and fill.

After the power house and spillway structure were completed, a cofferdam was erected behind the trestle and the river then discharged through sluicegate openings beneath the main Tainter gates of the spillway. All of the material for the fill or dike was sluiced from a 135-ft. hill adjoining the power site. For construction purposes a temporary steam plant was erected at Cooke, containing a Corliss engine which, through line shafts, drove two sluicing pumps, delivering 200 lb. per square inch through 6-in. discharge lines; one 200-kw alternator for supplying lamps and motors, and one 200-kw, 500-volt direct-current machine operating the gravel-train locomotive and pile-driver. Four 2-in. nozzles of the hydraulic giant type were used to loosen the material on the 125-ft. hill. The sand, clay and gravel thus dislodged under the impact of these 200-lb. streams was shunted into 20-in. semi-circular No. 8 steel troughs, carried on timber trestle over the core wall of the dike, the earth protection of the latter being compacted out of sand and clay in this way. Small portable dams were used to deposit the material where wanted, pools being formed in which the suspended matter was precipitated, while the water was drained off through spouts embedded in the dam material. An area of the hilltop six or seven acres in extent was cut down in places 18 ft. in this way, some of the material being delivered a total distance of 1500 ft. The dike wall was carried to a flat top 45 ft. above the tailwater level. After completion the buried timbers were left in place in the compacted clay and sand.

This sluicing work done on the earth fill revealed some interesting results concerning the quantity of material which water in motion can transport. The slope angle of

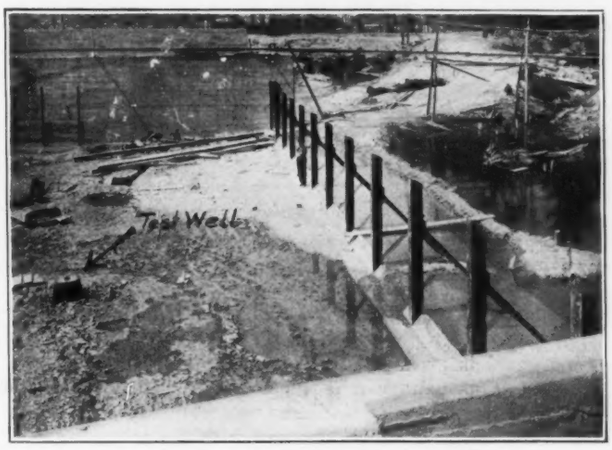


Fig. 15—Racks for Test Wires in Tailrace.

the trestled sluiceway varied between 6.5 and 8 per cent, and a careful log, with readings taken at fifteen-minute intervals, was kept of the material removed and the water used. In July 38,000 cu. yd. of sand was handled, representing 65 per cent of the weight of the water required to move it. In June and August, when sand was also handled, the ratio of solids to water was 55 and 49 per cent respectively. In September the ratio for clay was found to be 16 per cent. A total of 150,000 cu. yd. of material was moved in this way.

The earth fill measures 490 ft. in length and is approximately 45 ft. high with a 20-ft. flat top and sides laid at a

Fig. 16—24-ft. by 13-ft. Tainter Gate at Cooke Plant.

two to one slope. On the water side of the fill, so placed that it forms a wash wall extending 2 ft. above the earth at the water level, is a 12-in. concrete core wall, reinforced with ⅜-in. bars. This wall extends the full length of the fill, 490 ft., and is carried several feet below the clay at an average depth of 53 ft. from the top of the wall.

Gravel for the cement plant was handled by a 54-hp electric locomotive, equipped with two 500-volt railway motors. A 15-hp alternating-current motor hoisted cement up the incline, while two 25-hp motors operated the 1½-ton cube mixers. The mixtures of the various batches were adjusted to meet the conditions where the material was placed. Two 35-hp pumps operated the elevators and there were two triplex pumps for general supply, their output being delivered to an overhead tank.

During the time work was in progress about 300 men lived in camp on the site of the work. The employees' camp was located on the hilltop across the river from the offices and storerooms. Boarding houses and sleeping quarters were provided for the unmarried men, while men with families were offered the free lease of 50-ft. by 25-ft. lots on which to build their own shacks, being required in return only to sign agreements to keep the premises clean. Nearly seventy-five of these individual shacks were erected in street formation. Each street was drained by an 8-in. tile sewer, opening into a common main. At the upper end of each sewer line there was installed an automatic flushing barrel, pivoted just below its center and so arranged that two or three times daily it would overbalance, discharging its contents suddenly into the sewer. These flushing barrels were adjusted to operate twice or more during the daytime and at least once with the diminished water pressure avail-

able at night. Sanitary toilets were constructed by setting up 12-in. tiles over the sewer lines.

All machinery for the plant had to be delivered to Au Sable, a town on the Detroit & Mackinaw Railroad, since wiped out by a forest fire, and there transferred to the Au Sable & Northwestern Railroad, a narrow-gage road which runs near the Cooke site. From the narrow-gage spur the heavy machines were unloaded and skidded down the side of the 135-ft. hill which furnished the material for the wing-wall fill. For transporting passengers and supplies to the plant in good weather a gasoline rail-car has been improvised from the chassis of a 40-hp automobile. This conveyance is fitted with narrow-gage flanged wheels and makes good time over the tracks of the lumber railroad, whose own train schedule hardly suits passenger convenience.

TESTS OF COOKE WATER-POWER PLANT.

The Cooke water-power plant includes several unusual permanent features contributing to the convenience with which hydraulic tests of any unit or all of them can be carried out. Thrown across the 108-ft. tailrace, 134 ft. below the power-house wall, is a row of permanent H-section weir posts extending 8 ft. above the concrete and braced by double 3-in. by 3-in. by ¼-in. V-pieces like sash. Frame plates can be inserted in the channels of the uprights, which are set on 7-ft. 6-in. centers, water-tight joints being made by 5-in. felt strips asphalted to the frames, which are held against the bearing plates by the water pressure. Across the top of the weir sections an accurately leveled sill is made possible by gage-plate sections bolted under slotted holes so that the whole sill can be accurately leveled when the weir is installed for a test. At equal distances on a line 20 ft. behind the weir posts are four permanent water-

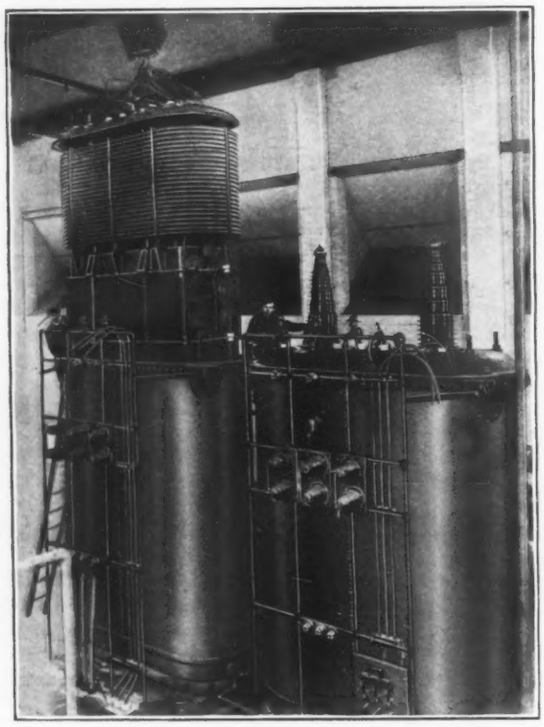


Fig. 17—140,000-Volt Transformer During Erection.

level wells, communicating through 2-in. pipes laid in the concrete with cisterns in observers' pits just outside the tailrace walls. Hook gages in these cisterns enable the height of water over the weir sill to be observed with accuracy, so that the water discharged by the turbines under test can be calculated. The test weir subtracts a fall of 4 ft. from the total 40-ft. head on the plant, connections being made for this difference in hydraulic pressure in computing the turbine performance.

At the time the Cooke plant was put into operation a complete acceptance test was made on the turbines, occupying the time of twenty-five observers for a week. All the observing stations were connected by an electric bell circuit, so that at the signal all readings could be taken simultaneously. An artificial load was provided by a water rheostat in the tailrace.

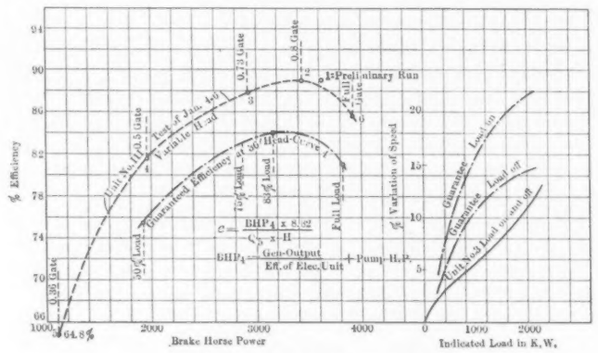


Fig. 18—Test Results of 4150-hp Turbine and Governor.

As shown by the accompanying curves, the actual performance of both turbines and governors exceeded expectations. At 3400-bhp load the efficiency of the turbines whose record is reproduced herewith reached 89 per cent, operating under 36-ft. head. The accompanying governor curve of the corresponding unit also shows that the regulation of this apparatus was practically identical whether the load was being taken on or off and was much better than had been specified originally.

No part of the construction has been by contract, all work being done within the owners' organization. The executive committee is composed of Mr. W. A. Foote, of Jackson, Mich., and Messrs. W. M. Eaton and B. C. Cobb, of the firm of Hodenpyl, Hardy & Company, 7 Wall Street, New York City, all practical and experienced men.

Mr. W. G. Fargo is hydraulic engineer for both the completed Cooke development and the Five Channels development under construction. A topographical survey of the entire basin of the Au Sable River was made by his force of engineers in 1908 and 1909, and studies are now being made for a third development. Mr. J. B. Foote, in addition to his many other official obligations to electric properties in Michigan, is general manager and electrical engineer and is responsible for the design, construction and operation of the unusual electric installation herein described.

AUTOMATIC FEATURES OF BOOSTER.

The 75-kw battery-charging motor-generator booster in the McComb Street substation of the Detroit Edison Company includes a number of automatic protective features. This unit is used in connection with the 11,000 amp-hr., eighty-cell storage battery and consists of a 110-hp motor driving a 55-volt generator designed for 1300 amp. The motor panel is arranged with an automatic overload trip, as well as a no-voltage-release coil inserted in its field circuit. The generator is similarly protected, its trips being interlocked through a back contact with the motor circuit-breaker. Operation of the motor circuit breaker for any cause will also open the generator switch, preventing the battery from discharging back through the generator. If the generator circuit is overloaded or interrupted the operation of its switch opens the motor circuit. Similarly, any interruption of the field circuit automatically removes the unit from service.

NETWORK OF ELECTRICAL CONDUCTORS—II.

Principles of and Simple Methods for Designing and Calculating Network Distribution Systems.

By Francis B. Crocker.

THE first section of this article, which appeared last week, gave an outline of the problems encountered in designing network systems and of the solutions that may be found for the most general case. The present section describes more fully the methods of dealing separately with locally circulating currents and distributed loads.

Network Calculation with Circulating Currents Only.—The simple case of one mesh of network from which current is not derived but merely circulates through it may be solved by applying the principle that current divides in the inverse ratio of the resistances of two paths offered to it. For example, if the resistance of one branch of the circuit between the points + and — in Fig. 4 is 0.02 ohm and of the other branch is 0.06 ohm, then $\frac{0.06}{0.02 + 0.06} = 0.75$ of the current will take the lower resistance path, and $\frac{0.02}{0.02 + 0.06} = 0.25$ will follow the higher resistance route, as indicated.

Imaginary Currents.—When there are two or more

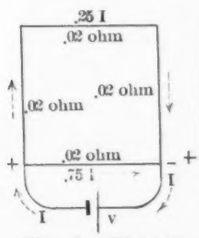


Fig. 4 — Division of Current in One Mesh.

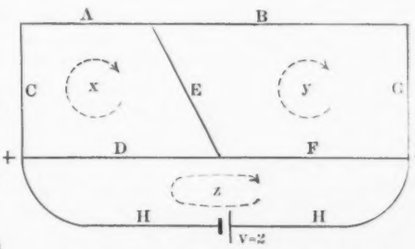


Fig. 5—Division of Current in Two Meshes.

meshes of a network acting merely to circulate current and from which none is derived—that is, no load is connected directly to them—the exact conditions in each section of conductor may be determined by means of Maxwell's imaginary currents, provided sufficient quantities are known. For example, the total potential difference and the resistances of all parts being given, the current in them may be calculated. For the purposes of such a calculation the actual currents are replaced by so-called "cycles," or imaginary currents, one of which is assumed to flow in the closed circuits formed by each mesh. For example, the simple network represented in Fig. 5 consists of two meshes and the source forming three closed circuits in which three cycles x, y and z are supposed to exist. The third mesh z is partly composed of the feeders $H\,H$ and contains the source of voltage V. To avoid confusion and because the true direction of current in some of the conductors is not known in advance, all of these imaginary currents are supposed to flow in a clockwise direction. Of course, the real currents may not have the same direction in all of the meshes. Moreover, the actual flow cannot be clockwise or anti-clockwise throughout any mesh or other circuit unless it contains a source of emf, because it is clearly impossible for a current to start at a point and flow around a circuit and back to the same point without potential difference. It is also manifest that the real currents in two adjoining meshes, corresponding to the cycles x and y in Fig. 5, cannot both be clockwise or both anti-clockwise, because they would be in opposite directions in the conductor E, which is common to them. On the other hand, such imaginary currents, although physically impossible, may be made to fulfil the algebraic conditions of the problem and thus enable one to determine the real currents. For example, 2 amp actually flowing in the wire E may be supposed to be the resultant of a cycle x of 5 amp and a cycle y of 3 amp. In this case the direction of the real current is downward in E, but if $x = 3$ and $y = 5$, then it would be upward, and if $x = y$ the current in $E = 0$. It may be found also that $x = 5$ and $y = 3$; that is, the imaginary current y is negative, which means that its direction is anti-clockwise, so that the true flow through $E = 5 - (-3) = 5 + 3 = 8$ amp in a downward direction. Thus any actual distribution of current may be represented and determined by assigning certain values and signs to the imaginary currents in accordance with the given conditions of each problem.

The resistance of all parts of the simple network in Fig. 5 are known, as is also the voltage V of the generator. The real but unknown current in each part is represented by the capital letter designating it and its resistance by the same letter small size; that is, the conductor E carries a current E and its resistance is e ohms. The combined resistance of the generator V and feeders $H\,H$ is h, and the corresponding current is H. From Kirchhoff's second law, the algebraic sum of all products of the currents and the resistances h, d and f that form the lower circuit is equal to the voltage v in that circuit; that is,

$$zh + (z - x)\,d + (z - y)\,f = v$$

Grouping

$$z\,(h + d + f) - xd - yf = v \qquad (1)$$

There being no emf in the other two meshes, the corresponding expressions for them are:

$$x\,(c + a + e + d) - ye - zd = 0 \qquad (2)$$

$$y\,(e + b + g + f) - zf - xe = 0 \qquad (3)$$

The first term of each equation is the product of the cycle or imaginary current and the total resistance of that particular mesh. Each other term consists of an adjacent cycle multiplied by the resistance common to both, and is negative because two clockwise imaginary currents are evidently opposed in a conductor common to both. The second member of the equation is zero except for a circuit containing a source of emf. Thus there are obtained as many simultaneous equations as there are unknown quantities, which in this case are the three cycles corresponding to the three circuits indicated. A simple numerical example will make the solution apparent. Assume the values $a = 0.2$, $b = 0.4$, $c = 0.2$, $d = 0.3$, $e = 0.3$, $f = 0.3$, $g = 0.2$, $h = 0.2$ and $v = 2.0$. These substituted in the above equations give

$$(0.2 + 0.3 + 0.3)\,z - 0.3\,x - 0.3\,y = 2.0$$
$$(0.2 + 0.2 + 0.3 + 0.3)\,x - 0.3\,y - 0.3\,z = 0$$
$$(0.3 + 0.4 + 0.2 + 0.3)\,y - 0.3\,z - 0.3\,x = 0$$

From which it is found that $x = 1.4$, $y = 1.2$ and $z = 3.5$. Starting with the circuit containing the source v, it is evident by inspecting Fig. 5 that the value found for the cycle $z = 3.5$ amp is the actual current that flows from the generator through the feeder H to the point + of the network. Here it divides. One part which must equal the ascertained value of the cycle $x = 1.4$ amp is carried by the conductors c and A, as represented. The current in D must be $z - x = 3.5 - 1.4 = 2.1$ amp; in E it is $x - y = 1.4 - 1.2 = 0.2$ amp, and in F it is $z - y = 3.5 - 1.2 = 2.3$ amp. Obviously the conductors B and G carry only the current of cycle $y = 1.2$ amp, which joins with 2.3 amp from F at the point — to form the 3.5 amp that returns to the generator V, as illustrated in Fig. 6.

Small numbers and a very simple network are selected for the sake of clearness, but it is manifest that any network which the current enters at one point and leaves at another may be similarly treated. The only difficulty is the tediousness of solving numerous simultaneous equations for many meshes; but considerable time and trouble may be saved by using determinants to solve the equations. In

the example above all of the cycles were found to have positive values, which means that the imaginary currents all circulate in a clockwise direction. If a negative value is obtained for a cycle it must be added to a positive quantity found for any contiguous mesh in order to get the resultant or real current that flows in the conductor common to both. In Fig. 5, for example, it is evident that a — value for cycle y would be added to a + quantity for

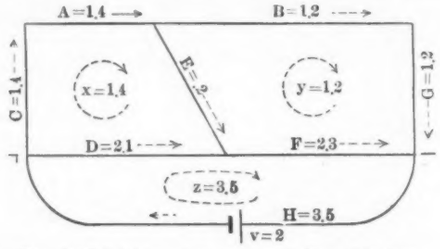


Fig. 6—Division of Current in Two Meshes.

cycle X to ascertain the actual current in their common conductor E. The direction of the real current in a feeder is known beforehand, and it is desirable for the assumed direction of the imaginary current to be the same. Hence in some cases it may be preferable to presuppose a counter-clockwise direction for all of the imaginary currents, some of which may be found later to have negative values or clockwise flow.

This method of calculation is readily applied to a network or portion thereof receiving energy at a given point and loaded at some other point. The simple network of Fig. 6, supplying a current of 3.5 amp at the point —, would have the distribution of current represented, if fed by 3.5 amp at the point +, and the total drop between those points would be 2 volts minus the loss in the feeders; that is, $2 - (3.5 \times 0.2) = 1.3$ volts. It is better at first to consider only the voltage drop in the network, the feeder being treated separately as a simple conductor in which the current is the total load in the network supplied by it, so that its length, resistance and drop are easily calculated or assumed. Kirchhoff's second law being true of any portion of a circuit as well as of the entire circuit, the cycle z in Fig. 5 may be regarded as having only the resistance of the mains D and F, and the voltage acting in it is the potential difference between the points + and —. This involves no change in the distribution of current or other conditions in the network. Moreover, in such cases it is not necessary that the load should be literally concentrated at one point, provided it is confined to a limited portion of the system. For example, a load distributed along a moderate length of main may be assumed to be concentrated at its middle point without involving any material error in results. In Fig. 7 such a case is represented by two rows of small circles on two sections of mains meeting at the point L, which is taken as the load center. The feeding point is the dot marked +, from which the network shown receives energy. An imaginary current or cycle is indicated by a current arrow n, p, q, etc., in each of the twelve meshes of the network. An additional circuit is formed by the source of current, feeders, feeding point + center of load L and mains connecting these two points, but the resistances of the source and of the feeders are not included and only the potential difference between points + and L is considered, as already explained. For this cycle it is not necessary to select any particular path along the mains, because the voltage drop from point + to point L must be the same whatever route is followed. Indeed, the current must apportion itself among the mains so that this essential condition is fulfilled. Naturally a simple route is chosen and in this case it is from point + to D and then to L. The resistances of the sections of mains included therein are e, f, g, h and b as indicated. It should be noted that the current in this cycle is only a part of that supplied by the feeder. There being many paths through the network, the equation for this route is—

$$(q - n)\, e + (r - o)\, f + rg + uh + yb = v \qquad (4)$$

That is, the sum of the products of current and resistance equals the total voltage drop v for this or any other current path. The equations for the other cycles are of the same form as those given for Fig. 5; being in the case of cycle q as follows:

$$q\,(e + j + k + l) - ne - rj - tk - pl = 0 \qquad (5)$$

and for cycle r

$$r\,(f + g + a + j) - of - ua - qj = 0 \qquad (6)$$

There would be as many of these latter equations as there are meshes in the network, which are twelve in Fig. 7 and there would be the same number of unknown quantities, that is the corresponding imaginary currents. It would seem, therefore, that these equations could be solved without using equation (4) but they contain only the relations between the currents in the various parts of the network. To obtain the actual values of current it is necessary to introduce the voltage contained in equation (4). This is in accordance with the fundamental physical fact that the distribution of continuous current in a system of conductors depends merely upon their resistances, the values being determined by the voltage and proportional thereto. Of course there would be no current whatever without emf.

After solving the simultaneous equations by ordinary algebraic methods or by determinants, the cycle value found for any outer mesh is the actual current in the outside main of that mesh. For example, the imaginary current of cycle r is the real current in section g. The true current in section f is $o - r$, and so on for all other parts of the mains. Before completing the calculations, which are laborious and often involve inadvertent errors, it is wise to check results by ascertaining whether Kirchhoff's first law is fulfilled at a given intersection of the mains; that is, whether the currents flowing to that point equal those flowing from it. For example, the four values obtained for cycles n, o, r and q enable the real currents to be found for the four mains d, f, j, e, as explained above, which latter currents must conform to the law at the point of intersection of the mains. The results may also be checked by finding whether the voltage drop from the feeding point to the load center by some other route, such as that by way of H, is the same as that by way of D. In explaining the use of imaginary currents this voltage drop and the resistances of the various parts of the network have been assumed to be known, because in each practical case the drop should be limited to a certain amount and the values of the resistances are easily fixed. The lengths of the main are found from a map of the district and their sizes may be selected because they are either standard or convenient. With these conditions prescribed the resulting currents may be greater or less than those required to supply the load, but that fact involves no difficulty. The total current may be increased or decreased in any desired ratio by a proportionate change in the cross-sections assumed for the mains. If the sum of the currents flowing into the network at the feeding point is found to be twice as great as the load, then all of the mains should be taken at one-half of their presupposed cross-sections. Of course this applies to the designing of the network. In the case of an existing system the location or number of the feeding points may be changed to obtain the proper amount and distribution of current. In Fig. 7 the correct condition exists when

$$\text{Feeder current} = \text{load} = (p - q) + (q - n) + (m - p) + (n - m)$$

By mere inspection one can determine how these quantities should be written, because all four currents must flow away from the feeding point. Hence $p > q$, $q > n$, etc., each parenthesis containing a positive quantity and the di-

rection of the imaginary currents r, q, m, n being the same as that of the real currents.

Determination of Resistance of Network.—Imaginary currents may easily be applied to ascertain the resistance of a certain network between any two given points thereof. A potential difference of 1 volt is supposed to exist between these points and the total current is determined as just explained. Evidently, then, the equivalent resistance R

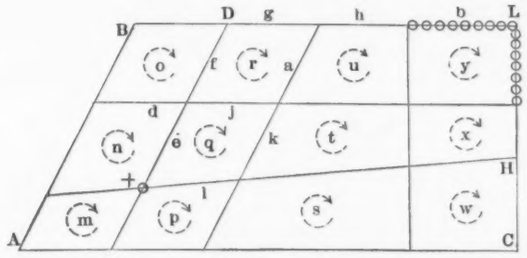


Fig. 7—Distribution of Current in Network of Several Meshes.

of the network is the same as that of a single conductor having a resistance in ohms equal to the reciprocal of the total current I in amperes, that is, $R = 1 \div I$.

The foregoing method of calculating the distribution of current and resistance of a network by means of Maxwell's imaginary currents applies to those cases in which all load is located at one point or is so confined to one portion of the mains that it may be regarded as concentrated at its middle point or load center. Such calculations are useful because these conditions sometimes exist or are approximated in practice and the results obtained are very instructive in showing how the current divides among the numerous paths. For example, the question often arises as to whether an existing system is able to supply energy to many lamps or motors in a large theater, hotel or other building located at some point within reach of its mains. The resistance of the network between the nearest feeding point and the building is determined as explained above, and is multiplied by the number of amperes to be supplied to find the drop in volts. In the course of the calculation the relative amounts of current in the different sections of mains are ascertained, and the actual current will dispose itself in the same proportion. The voltage drop obtained is a maximum value because current will also be contributed by other feeders. If, for example, there are two or more feeding points in the neighborhood, then the resistance is determined for each and the ratio of current furnished will be inversely proportional to the respective resistances. The drop equals the current supplied by a certain feeder multiplied by the resistance between it and the given load, being of course the same for all of the feeders. It is not necessary to consider those feeding points from which the resistance is many times as great as from the nearest one, their effect being correspondingly small. Any error thus involved is in the right direction because the actual drop as well as the currents would be less than the calculated values.

In determining the resistance between a feeding point and a load center or other point of a network it is convenient to assign a potential difference equal to the maximum permissible drop. The resulting currents in the various mains as well as the total are then limiting values not to be exceeded.

Distributed Load in Networks.—In most practical systems for supplying electrical energy the load is distributed along the mains and not concentrated at or near one point. This distribution is usually far from uniform, but more or less lamps or other devices are connected to most of the sections of main. Ordinarily it is allowable to regard the load on each section as concentrated at the middle point of the load. For example, the current consumed in a city block of moderate size may be considered to be supplied from the load center of the main serving that block.

An example of this kind is indicated in Fig. 8. The line V_1V_2 represents a section of a main forming part of a network, the potentials at its ends being V_1 and V_2 respectively, and the potential difference between them being $v = V_1 - V_2$. A certain number of lamps connected to this section consume a current of I amp. The load is either concentrated at the point I or may be so regarded because this is its center. The resistance of the section between V_1 and I is a and between V_2 and I is b and its total resistance $a + b = r$. The current from V_1 to I is A and from V_2 to I is B, so that the *derived* current $I = A + B$, but either A or B may be negative, as shown later. Evidently v equals the difference in voltage drop between V_1 and V_2 and the point I; that is, $v = Aa + Bb$, from which by substituting the values of a and B there are obtained

$$A = \frac{v}{r} + \frac{Ib}{r} \text{ and } B = -\frac{v}{r} + \frac{Ia}{r} \qquad (7)$$

The term $\frac{v}{r}$ represents the current that would flow through the conductor according to Ohm's law if there were no load or derived current supplied. For that reason it is sometimes called the "ohmic current," but that is a poor distinguishing name, as it applies to all direct-current and many alternating-current cases. *Circulating* current is a better designation. It should be noted, however, that the actual current in a section of main is equal to $\frac{v}{r}$ only when there is no load upon it. The effect of any derived current is to make the real current greater, less or even reversed with reference to $\frac{v}{r}$. The fact that this term changes its sign in the second equation simply represents the condition that this circulating current flows through the resistance from V_1 to V_2, due to v, the potential difference between them; or, rather, the effect is the same as if it did flow. The direction agrees with that of current A but is opposed to B, hence it is + with respect to the former and — with respect to the latter. Of course, all of these relations are algebraic and the actual currents may not have the directions indicated. For example, if $a = 0.02$ ohm, $b = 0.01$ ohm, $r = 0.03$ ohm, $I = 75$ amp, $v = 1.5$ volts, then the drop from V_1 to $I = 75 \times 0.02 = 1.5$ volts, which is the same as V. Hence there is no potential difference in the conductor and current $B = 0$, so that $A = I = 75$ amp, as indicated in Fig. 9. The resistance b has no effect and may have any value; in fact, this conductor may be cut or removed entirely without changing A or I. Substituting the above values in equation (7):

$$A = \frac{1.5}{0.03} + \frac{75 \times 0.01}{0.03} = 75; \quad B = -\frac{1.5}{0.03} + \frac{75 \times 0.02}{0.03} = 0$$

Consider another case in which $a = 0.02$, $b = 0.01$ and $r = 0.03$ ohm as before, but $I = 125$ amp and $v = 1$ volt, as represented in Fig. 10. Then

$$A = \frac{1}{0.03} + \frac{125 \times 0.01}{0.03} = 75;$$

$$B = -\frac{1}{0.03} + \frac{125 \times 0.02}{0.03} = 50$$

These currents flow from both ends of the section to form

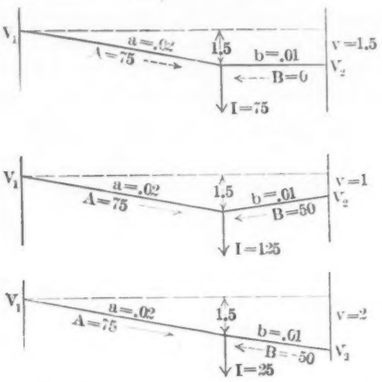
Fig. 8—Loaded Main Fed from Both Ends.

the derived current I and no actual circulating current passes from V_1 to V_2.

In the third example, shown in Fig. 11, with resistances the same as before but $I = 25$ amp and $v = 2$ volts:

$$A = \frac{2}{0.03} + \frac{25 \times 0.01}{0.03} = 75; \; B = \frac{-2.0}{0.03} + \frac{25 \times 0.02}{0.03} = -50$$

The current B is negative, that is it flows *away* from I and must be subtracted from A to obtain the value of the derived current I. The same 50 amp does pass all the way through the conductor and issue at V_2, but this is not the value of the so-called circulating current, which in this case is $2 \div 0.03 = 66\frac{2}{3}$. Manifestly the term $\frac{v}{r}$ does not represent an actual current in any of these cases, but



Figs. 9, 10 and 11—Currents and Voltages in Loaded Main Fed from Both Ends.

merely the current that there would be with no derived current. The other terms $\frac{I_b}{r}$ and $\frac{I_a}{r}$ of these two equations are the amount of current that would flow from the two ends of the section if they were of the same potential, in which case $v \div r = 0$. Under this condition there are simply two paths for the current, which apportions itself inversely as their respective resistances. Even when v is not zero, these two terms represent two components, the sum of which is I, because $\frac{v}{r}$ and $-\frac{v}{r}$ cancel. Without affecting the rest of the network the load or derived current I may be replaced by its two components referred respectively to the ends of the section of main to which the load is connected.

The above method is applicable to the case of currents derived from two or more connected sections of main.

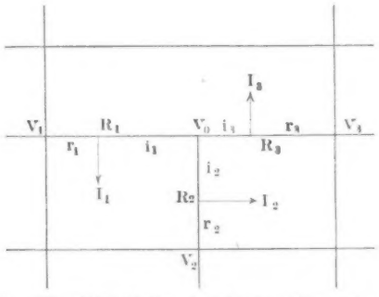


Fig. 12—Distributed Loads in Networks.

Each current is resolved in this way into components, and of course the sum of all of these components is equal to the sum of the derived currents.

In the portion of a network represented in Fig. 12 the potentials at the intersections of the mains are V_0, V_1, V_2 and V_3. The resistances between the points V_1, V_2 and V_3 and the three derived loads I_1, I_2, I_3 are r_1, r_2 and r_3 respectively. The three currents from V_0 to these loads are i_1, i_2 and i_3. From equation (7) are obtained

$$i_1 = \frac{V_0 - V_1}{R_1} + I_1 \frac{r_1}{R_1} \quad (8)$$

$$i_2 = \frac{V_0 - V_2}{R_2} + I_2 \frac{r_2}{R_2} \quad (9)$$

$$i_3 = \frac{V_0 - V_3}{R_3} + I_3 \frac{r_3}{R_3} \quad (10)$$

Adding these equations and remembering that the three currents meeting at a point = 0,

$$\frac{V_1 - V_0}{R_1} + \frac{V_2 - V_0}{R_2} + \frac{V_3 - V_0}{R_3} = I_1 \frac{r_1}{R_1} + I_2 \frac{r_2}{R_2} + I_3 \frac{r_3}{R_3} \quad (11)$$

That is,

$$\sum \frac{V - V_0}{R} = \sum I \frac{r}{R} \quad (12)$$

With several currents derived from the same section of main (that is, loads connected at two or more points upon it) the method just described may be applied. It is not necessary to consider each branch connection separately if they are many or small. For example, currents con-

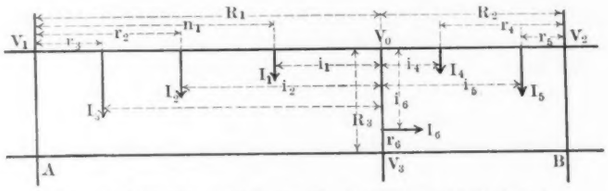


Fig. 13—Several Loads on Each Section of Network.

sumed by several small adjoining buildings may be combined and considered as one current derived from the main at the load center of the group. In fact, it is usually allowable to treat in this way the total current used by a block of buildings. When, however, the section of main is long or the loads particularly heavy at two or more points upon it, the resulting conditions may be calculated as follows: Three sections of main having resistances R_1, R_2 and R_3 are connected at the point V_0 in the portion of network represented in Fig. 13. From the long section R_1 three load currents I_1, I_2 and I_3 are derived, being supplied respectively by the three constituent currents i_1, i_2 and i_3 flowing in the main from the point V_0. The respective resistances between the points of derivation of I_1, I_2 and I_3 and the other end V_1 of the section are r_1, r_2 and r_3. The potentials at the ends of the section are V_0 and V_1. There are two loads I_4 and I_5 upon the rather long section R_2 with corresponding currents i_4, i_5 and resistances r_4, r_5, the terminal potentials being V_0 and V_2.

The short section R_3 has only one load I_6 with correlated current i_6, resistance r_6 and terminal voltage V_3. All of these facts are clearly indicated in the diagram. From what has been explained, current in R_1 from $V_0 = i_1 + i_2 + i_3$

$$= \frac{V_0 - V_1}{R_1} + \frac{I_1 r_1 + I_2 r_2 + I_3 r_3}{R_1}, \quad (13)$$

current in R_2 from $V_0 = i_4 + i_5$

$$= \frac{V_0 - V_2}{R_2} + \frac{I_4 r_4 + I_5 r_5}{R_2}, \quad (14)$$

and current in R_3 from $V_0 = i_6$

$$= \frac{V_0 - V_3}{R_3} + \frac{I_6 r_6}{R_3} \quad (15)$$

Except in the case of a feeding point, the sum of these currents must be zero, by Kirchhoff's first law, hence

$$\frac{V_1 - V_0}{R_1} + \frac{V_2 - V_0}{R_2} + \frac{V_3 - V_0}{R_3} = \frac{I_1 r_1 + I_2 r_2 + I_3 r_3}{R_1} + \frac{I_4 r_4 + I_5 r_5}{R_2} + \frac{I_6 r_6}{R_3} \quad (16)$$

For a feeding point the sum of the currents on the mains,

that is, $i_1+i_2+i_3+i_4+i_5+i_6$, must equal the current supplied by the feeder. In the above equations the values of all loads and resistances are usually known.

By assigning to V_1, V_2 and V_3 the lowest permissible voltage the value of V_0 is found from the equation. If this is too high, then some of the load currents, I_1, I_2, etc., must be reduced. When V_0 is the voltage at a feeding point, which is known, and it is desired to determine V_1, V_2 and V_3, it is necessary to have three simultaneous equations. These are of the same general form as equation (16), but are stated with reference to each of the three unknown quantities. For example, the first of these equations would be

$$\frac{V_0-V_1}{R_1}+\frac{V_2-V_1}{R_1+R_2}+\frac{V_3-V_1}{R_1+R_3}=\frac{I_3(R_1-r_3)+I_2(R_1+r_2)+I_1(R_1+R_1+r_1)}{R_1}+\frac{I_4r_4+I_5r_5}{R_1+R_2}+\frac{I_6r_6}{R_1+R_3} \qquad (17)$$

There are two other similar equations referred to, V_2 and V_3 respectively. The paths from V_3 to V_1 and V_2 should be taken via A and B so as to differ from V_3 to V_0. In fact, there are many possible paths through a network so that a corresponding number of simultaneous equations may be obtained.

In practice the voltages at the feeding points are known or assigned so that the potential difference between the ends of any main or combination of mains extending from one to another is known. The currents that flow away laterally from the given main to other mains connected to it may be treated the same as the load supplied by it. In fact, an equation of the same form as equation (16) may be employed to determine how much current will be contributed in this way to other mains, when that is the only unknown quantity.

In a final instalment of this article a description will be given of the "cutting-point" method of determining the currents in any portion of a network, and the so-called "tree system" of current distribution will be discussed.

ELECTRIC-VEHICLE SERVICE OF THE LOWELL ELECTRIC LIGHT CORPORATION.

One of the first central stations in Massachusetts to discard horses in its transportation service was the Lowell Electric Light Corporation, one of the best-known Stone & Webster properties in the East. The company serves the municipalities of Lowell, Billerica, Chelmsford, Westford, Tyngsboro, Dracut and Tewksbury, and its lines cover an extensive rural and suburban area, besides the populous residential and business district of the city. The transportation of men and materials to various points on the system was long ago recognized by the management as a substantial expense, and about a year ago the possibilities of the electric vehicle were investigated, with the result that five electric machines are at present in service, all but one having been placed in commission since April, 1911.

The equipment now in operation consists of an old gasoline car which was converted into an electric runabout and which is in only temporary service; a 750-lb. General Vehicle wagon equipped with forty-eight cells of Edison "A-4" battery; a 1000-lb., a 2000-lb. and a 3000-lb. Detroit electric truck installation, each of the latter three machines equipped with sixty-two cells of Edison battery, the sizes being the "A-4," "A-6" and "A-8" respectively. The company displaced five horses with these equipments, but is doing twice the amount of work that was accomplished under the old régime, so that there has been an equivalent displacement of ten horses.

The 750-lb. wagon is used from 7 a. m. until midnight, the daylight service being lamp trimming and changing in connection with the arc system. In the evening the wagon is operated in inspection and trouble-call service. The 1000-lb. wagon is used in meter installation work and runs about ten hours per day. The 2000-lb. and 3000-lb. trucks are operated in line-construction service. All the vehicles are provided with single-motor equipments, and each machine is furnished with a Sangamo ampere-hour meter. The

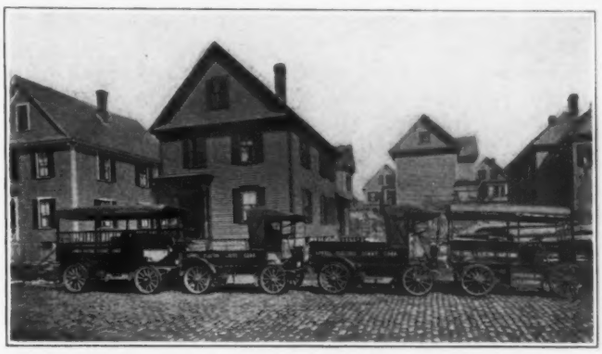


Fig. 1—Electric Trucks at Lowell.

battery boxes were lined with asbestos at the beginning of the winter season to protect the electrolyte from low temperatures, and the result has been thoroughly satisfactory operation. At present the machines are housed at a garage fitted up by the company at its power plant property, this being about half a mile from the center of Lowell. A new garage will shortly be built on the premises, and the facilities of the company for handling commercial charging will be greatly extended.

A distinctive feature of the work at Lowell is the scientific study of operation which the company is making in connection with all its electric vehicles. Each charging panel in the garage is equipped with a recording wattmeter, eight circuits being at present available. A complete system of records is maintained. A daily report is prepared and sent to the office of the electrical engineer covering the results of a thorough inspection of the equipment of each machine, including the motor and its parts, controller, running and steering gear, brakes, tires, lamps, etc.; washing, repairs and battery inspection and maintenance. All supplies used on each machine are included in the record. Another form of the same size gives a daily record of the garage meter readings, including full information as to the charging and discharging of all batteries, mileage, loads on machines, road conditions and watt-hour inputs to the equipments used in battery charging.

Each motor-vehicle owned by the company is provided with a 10-in. by 12-in. card record, showing for every day in the month the miles run, the odometer reading, driver, average load, road conditions, ampere-hours used, ampere-hours per mile run, watt-hours input to the battery, watt-hours used per mile run, overcharge, if any, primary kw-hours chargeable to the machine on the garage supply circuit, and amount of material and labor required in repairs and washing. A typical record of monthly averages is given in the accompanying table for the 2000-lb. truck, the machine averaging 20 miles per day in regular service.

RECORD OF MONTHLY AVERAGES.

	Watt-hours Input to Battery per Mile Run.	Ampere-hours of Battery Discharge per Mile.
July, 1911	623	4.66
August, 1911	632	4.90
September, 1911	663	4.72
October, 1911	608	4.08
November, 1911	765	4.69
December, 1911	704	4.63
January, 1912	1008	6.20
February, 1912	829	5.62

The records show the effect of winter weather, with heavy snows, upon the energy consumption of the vehicle.

The "converted" gasoline outfit and the 1000-lb. electric equipment are each provided with a Sangamo watt-hour meter calibrated between 60 and 115 volts, in addition to the regular amp-hour meter. The watt-hour meter is provided with two registers with ratchet drives, indicating respectively the energy taken in charging and yielded in discharging.

A special report blank is used weekly to record the time and money saved by electric trucks over the same work with horses. The daily mileage and time saved each man in the force by using the truck are indicated. From $10 to $15 per week is frequently saved through the more rapid transportation of the men to the work in the field gained through the use of the electric vehicle. The company's lines extend to a point 14 miles from the generating station, and this distance can easily be covered in 1 hour 10 minutes with the

AUTOMOBILE INSPECTION AND REPAIR SHEET

FOR 24 HOURS ENDING 7 A. M.								
INSPECTION (excl. Battery)								
Motor—Bearings								
—Brushes								
—Commutator								
Controller								
Steering Gear								
Counter Shaft—Bearings								
Sprockets								
First Reduction Chain								
Second " "								
Brakes—Rear Wheels								
—Counter Shaft								
Tires								
Lamps—Head and Tail								
—Extension and Test								
Grease Cups Filled								
Grease used (in Quarts)								
Oiled								
Oil used (in Quarts)								
Total Time for Inspection								
WASHING								
REPAIRS (excluding Battery)								
State carefully repairs made and material used for different cars.								
INSPECTION OF BATTERY								
Number under corr. car number								
Cleanliness								
Connections								
Distilled Water (in Quarts)								
Electrolyte (" ")								
Total Time for Inspection								
REPAIRS ON BATTERY								
State repairs, material etc.								

Fig. 2—Daily Report Blank.

trucks, compared with the street car running time of about 1 hour 30 minutes, with delays in waiting for connections and the necessity of paying a 30-cent fare per man for the round trip. The electric railway service to the remoter portions of the system is maintained on an hourly basis, while the electric vehicles are available at all times.

All the company's modern electric vehicles average 20 miles daily service each, and in practically any case where the conditions require it the company can count upon at least 35 miles per day in good weather. Eighteen employees of the company are now licensed operators. All machines bear the company's initials on the battery box and the statement that they are operated by central-station energy. All of the cars are painted a standard color and are charged during the night. There are as yet comparatively few electric vehicles in service in Lowell outside those above described, but the company's careful study of its own service has placed it in a better position to advise prospective customers than in cases where no reliable data are available. With the establishment of the new garage, an active campaign of expansion will be a direct result.

At a recent hearing before the Massachusetts Gas & Electric Light Commission, Mr. A. Stuart Pratt, of the Stone & Webster Management Association, called the attention of the board to the great interest of central stations in electric vehicles and pointed out that the Lowell company has eliminated all its horse and wagon service. "The reports which we get from this territory show that it has been a great success, not so much in reduction of operating expenses, although the company claims some advantage there, but materially in celerity of movement. We can get to breaks quicker and do more effective work in the time. We hope it will be advertised to the merchants on the street and that they will see the advantage of electric vehicles and gradually install trucks. I think, perhaps, it is not too much to say that inside of ten years hardly a horse will be seen in the congested parts of the large cities. We have gone into this with care. While we are probably prejudiced in favor of electric traction, we have given it scientific study and have satisfied ourselves that electric traction for city work for trucks is the coming form rather than gasoline trucks. We are looking forward to the time when the central station will get a large and valuable load from electric vehicles, especially electric trucks. We have charged these trucks to the plant account. We should not think for a moment of charging gasoline vehicles of any kind to plant. The experience of the gasoline vehicle up to now is that its effective life is hardly more than three years. We depreciate those so that they are entirely charged to expense in two years' time, but our experience, which covers four or five years, shows that we are right; that after two years not much of value is left in a gasoline runabout. We give it hard service. Probably a man using the same thing as a pleasure vehicle would find longer life, but we find it comparatively short.

"The electric truck is a different proposition. It is simple in construction, and anyone can drive it. It is purely a question of steering. The electric truck is pretty nearly foolproof. A man can hardly get into serious trouble. He cannot overspeed it, because it is designed to go on full speed except when teams are in the way. Everyone in our line of business knows that a motor and a storage battery are all that there are to an electric truck, with steering gear and frame. The equipment is simple and there is very little to wear out. We figure that the trucks will have an effective life of at least ten years."

UNDERGROUND DISTILLATION OF COAL.

The recent proposal by Sir William Ramsay, the English scientist, to obtain gas direct from coal as it lies in the earth is soon to be given a practical trial, it is announced, in a coal-mining property loaned for the purpose. It is proposed to drill a hole about 1½ ft. in diameter down to the stratum of coal and insert three concentric tubes or well-casings. Air will be forced down the central tube, in necessarily limited quantities, and provide the oxygen for enough combustion and heat generation to commence the distillation of the surrounding coal. The liberated gases will rise to the surface through the space between the inner and middle tubes.

It is expected that gas of a quality equal to that obtained from producers will be secured in this way. The first experiments will be conducted in a stratum of no value from a mining standpoint. Included in the original suggestion is a plan to utilize such gases in internal-combustion engines situated near by, transmitting and distributing the energy by electrical means to a large market. The announcement contains the claim that by this method of utilizing the coal supplies the cost of energy can be greatly reduced.

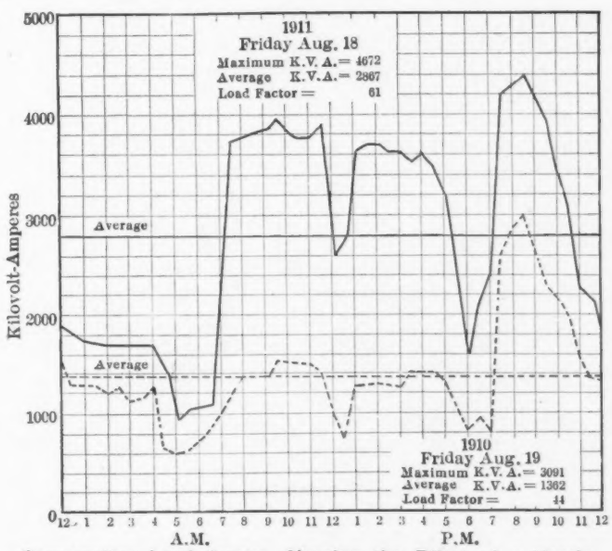
Central Station
Management, Policies and Commercial Methods

CENTRAL-STATION BUSINESS AT WORCESTER.

The Worcester (Mass.) Electric Light Company has effected a substantial increase in its gross revenue during the past year by the adoption of a vigorous commercial policy of systematic soliciting and publicity. Thirteen solicitors are now in the company's field. The motor-service business is increasing by the addition of about 200 hp in connected motor load per month, and in January, 1912, the gross earnings were 27 per cent larger than in January, 1911, the February earnings being 32 per cent greater than in the preceding year. The company now operates 530 house-lighting installations on a flat rate and is beginning to supply energy to mercantile houses on the basis of a fixed monthly charge. The connected motor load is now 7700 hp, and in a short time the city will be illuminated by 1000 arc lamps of the 4-amp magnetite type. The connected lighting load aggregates 161,000 16-cp equivalents and 1153 75-watt tungsten lamps. In all its advertising the company utilizes the slogan "At your service" in a triangular setting, and the business cards of employees are standardized along the line of emphasizing the business opportunities in Worcester, the employees' name and company being signed and printed at the bottom in less conspicuous characters. At the recent Springfield convention of the New England Section of the N. E. L. A. the company had nineteen representatives on hand, each wearing red "Worcester" ribbons carrying the company slogan. Among the company's guests were several prominent wiring contractors.

COMMERCIAL EFFORTS AT MILWAUKEE.

Near the close of the year 1910 The Milwaukee Electric Railway & Light Company organized a commercial and sales department the details of the formation of which were given on page 1423 of the *Electrical World* of Dec. 15, 1910. The accompanying sample load curves taken from the Milwaukee generating system show the result of ten months' sales effort of this new department in increasing the motor and lighting business. In August, 1910, the peak load of the 60-cycle system reached 3000 kw and the average load for the day was 1350 kw, indicating a load-factor of 44 per cent. A year later the average load for the twenty-four hours had nearly equaled the peak load of the preceding August, while the maximum 1911 load reached 4500 kw, showing a load-factor of 61 per cent.



Comparative Load Curves, Showing the Effect of a Year's Campaign.

The following table, giving data on increase of motor load, shows that not only did the total connected horse-power increase largely, but the customer's horse-power and number of motors also increased, indicating that the larger classes of power users were being reached:

	1910.	1911.	Increase.	Per Cent.
Number of customers	1,009	1,260	251	25
Number of motors	1,567	2,156	589	37
Horse-power connected	10,122	17,018	6,896	68
Horse-power per customer	10	13.5	3.5	35
Motors per customer	1.5	1.7	0.2	13

The Milwaukee company's sales department was originally organized by Mr. C. N. Duffy, comptroller, and was later placed in charge of Mr. Egbert Douglass as sales manager.

CENTRAL-STATION HEATING.

In a talk on central-station heating before the St. Louis League of Electrical Interests on March 5, Mr. F. N. Jewett discussed the electric central-station manager's relation to the heating problem in considering isolated-plant competition. The manner in which this problem has been met in Detroit, Milwaukee, Chicago and Rochester was outlined briefly. He said that central-station heating has long since passed the experimental stage and is now on a substantial basis. Many managers of central-station electric plants are of the opinion that if they install a central-station heating system it will increase the cost of generating electricity to such an extent that this cost will not be offset by the revenue derived from the sale of heat. The speaker said that this belief is justified only in a few places, where the electric load on any one engine far exceeds the total heat load. The possibility of economy in steam engines of any class lies almost entirely in the range of the thermometer scale through which the heat can be driven, or, in other words, the "heat head." Mr. Jewett continued:

"With coal having a thermal value of 12,000 lb.-Fahr. units per pound and an average evaporation of 7 lb. of water per pound of coal burned, it will be seen that in modern station equipment, with so-called high-economy prime movers, only 4.5 per cent of the total heat value of the coal is utilized and approximately only 15 per cent of the heat delivered to the engines is actually turned into power. Here is where we may assist in the conserving of the natural resources by utilizing the heat which is now dissipated through the condenser or thrown away in the exhaust to the atmosphere by conveying it to buildings which require artificial heat during several months of the year."

As to the most desirable method of conveying the heat from the engine to the point where it is to be utilized, the speaker said that there is no doubt in the minds of engineers with knowledge of the heating business that the use of water heated by exhaust steam from engines and circulated by means of a centrifugal pump is by far the

most economical method of transmitting the heat to the point where it is to be utilized. However, as a matter of fact, the number of buildings with existing equipment for steam heating is far in excess of those that are heated by water, and this is particularly true in business districts. Therefore, if a steam system of district heating is installed the existing plants, consisting of radiators, pipings, etc., on the premises can be used directly, and also if hot-water heating is used on the customer's premises the steam supplied from the district-heating system can be used economically to heat the water in the individual building system, continuing the circulation of hot water in the individual buildings. Thus market conditions may prohibit the introduction of hot-water district heating.

With a system properly installed it is practical to utilize approximately 90 per cent of the heat supplied to the engine, less transmission losses, instead of 15 per cent, as in the case of a condensing engine with no heating combination.

Mr. Jewett gave figures to show that if the steam required for a district-heating load equals or exceeds that required for the engine load on a non-condensing basis, the revenue from the sale of heat will be more than enough to pay the total cost of fuel for the combination.

The speaker closed by describing an ideal district-heating system in which water is used as the medium, the circulation being mechanically produced and maintained. He noted, however, that the ideal is not always practical, and in fact conditions may be such that the attainment of the ideal is impossible. He mentioned the fact that in plants where large volumes of waste hot gases are available, as from boilers, ovens, mufflers, etc., these gases may be sent through a fuel economizer and utilized for heating purposes, the water being heated in the economizer. In the same way, about 50 per cent of the heat absorbed in the water jackets of gas engines may be utilized for heating purposes. This is a new application of this method of heating and is worthy of consideration.

HANDLING COMPLAINTS AT BOSTON.

At a recent meeting of the Boston Edison Section of the National Electric Light Association Mr. E. C. Kimball, of the company, presented a paper describing the method of handling complaints in that organization, which now serves a large part of the Boston and suburban district and covers a territory of nearly 600 square miles. Few central stations in the country have given the subject of complaints the scientific study and liberal treatment practised in Boston, and on account of the human interest and public importance of such work an abstract of the paper is given below.

The complaint division of a central station must occupy the position of an arbitrator, unbiased by prejudice, ready to recognize that the company may sometimes be in the wrong, and prepared to acknowledge mistakes. Of the complaints made to the Boston company in the past year, 51 per cent were analyzed as warranted. The supplying company must always give the customer the full benefit of its experience and in case of doubt give the consumer the benefit. Few employees realize how little knowledge customers have of the system supplying energy to them. The small user does not have the advantage that the large one may through the agent's close association with all departments. Until the small user secures his service and receives his first bill he is largely in the dark as to the exact relations which exist between himself and the company. If the first bill leads to a complaint or inquiry, then the time is riper for making a friend of the customer than it is ever likely to be again.

The first point of inquiry should be the accuracy of the meter reading. The customer has no way of knowing that the meter record is continuous and until the fact is explained he has every reason to suppose that an error results in an excessive cost to him. It is the company's policy to ask the customer to mark upon a meter-reading slip the position of the hands and to return it to the office for comparison. Many complaints would be obviated if all customers could be educated to compare their meter readings monthly. The accuracy of meter readings and tests is a point to bring home. Of the total number of meters installed on the lines of the company, 36,650 were tested in the past year, the average full-load error being less than 2 per cent slow, and at light load less than 5 per cent slow. Of 1150 complaint tests made last year there were only 162 cases where the error was over 5 per cent, and only 3 per cent of the allowances made were for meter error, despite the practice of adjusting all errors on the basis of the maximum error, allowing the percentage of error for one-half the energy consumption since the previous test. If the company did not find a fast meter once in awhile, there would be no occasion to show how liberally it deals with such a case, and there would be nothing to brag about to the 90 per cent of the customers who get nothing as a result of the meter's proving correct on test. If the reading and the meter are correct, the only important factor left is the possibility of misconnections.

The company often shows the customer that the result of his complaint is good, even if the company has been unable to adjust his bill on account of meter error. In a typical case a large grocer was about to go over to competitors because a rate could not be made that he felt would meet his conditions of short-hour burning. He had formerly been favored in his rate under the old quantity discount system, which at the time of standardization of his rate resulted in a material increase in his bill. By the use of 100-watt tungsten lamps with bowl reflectors a final net saving of 75 per cent was effected, with a much longer hour use and improved store.

The company's policy has always been to give the customer the advantage of the best rate under its schedules, with a retroactive allowance in case it is discovered that the customer has not been getting the full benefits. Of the allowances made last year, 62.5 per cent were on account of change of rate.

Last year 5350 complaints were received. Complaints warranted are subdivided under the headings of "Apparatus rental canceled," "change of rate," "adjustment of fixed charges," "settled by explanation," "fast meter or indicator," "minimum canceled," "violated contract," "charge canceled" and "miscellaneous." Under the division of "complaints unwarranted" the company makes two subdivisions, namely, "unwarranted, new complaint" and "unwarranted, old complaint," each division being further subdivided as "customer convinced" and "customer unconvinced," with further detailed classification. Under the analysis of "customer convinced," where the complaints were unwarranted, the company investigated 2600 out of the total of 5350, and under the classification of "customer unconvinced" the company had fifty complaints, in all of which an allowance was made to the customer to satisfy him, this being 4 per cent of the total allowances. Experience shows that this liberal policy is appreciated and that it is seldom abused.

A full knowledge of the intention of the company to grant the customer the advantage of the best rates upon an absolutely standard schedule which is applied to all similar conditions tends to raise the confidence with which the public meets the central-station representative. This, with the endeavor to meet all complainants courteously and with unfailing good nature, will eventually break down that feeling of the lack of the personal equation which has seemed to come into the relations of the public with the corporations.

There is no closer personal attention given to any question governing the sale and use of any commodity than the

company is to-day giving to a complaint of electric service. If it is a complaint of poor service or low voltage, trained engineers investigate it. If it is a complaint against a bill, there are employees who devote their entire time to an analysis of the conditions leading up to and involved in the determining factors of the charge. Readings are checked, meters are tested, wiring is traced out for all possible errors, the rate question is investigated and comparisons are made to determine the best possible rate under the schedule. Illuminating engineers are called upon to determine the question of illumination in relation to cost and energy expended; motor experts are detailed to give the customer the best available opinion as to the adaptation of electricity to his needs; in fact, more is done for the customer than he would think of doing for himself or would have done for him even if he went into the market to engage the services of outside engineers. Correction is made fully and freely in case of error. Slight monetary allowances, when justified by the facts, are helpful in disarming the chronic complainant. Even the arguments of the "trust buster" shrivel in the light of facts and indiscriminatory treatment.

CENTRAL-STATION SERVICE IN SMALL KANSAS TOWNS.

The Kansas Gas & Electric Company supplies energy not only for the city of Wichita and its street railway but for the interurban line in Arkansas Valley as well, and the small towns along this line are not slow to take advantage of the opportunity for electricity which the system affords.

Ten miles north of Wichita is a little city, Valley Center. It is a community of retired farmers, of about 450 population, and contains about 100 houses and business buildings. The only elevator in town is operated by 20 hp in motors. The main business street is lighted from dusk until 10 o'clock six nights and until 12 o'clock on Saturday night of each week by a "white way" of nineteen lamps paid for by the merchants. In addition, the city pays for eleven street lamps located in different parts of the town. Not much house wiring has as yet been done, as electricity has been available for only a short time. Mayor Gardiner estimates that fully 50 per cent of the buildings will be connected up during the spring. Mr. Gardiner, who is also the banker in Valley Center, stated that the street-lighting investment had proved a good one, inasmuch as the service of the city marshal had been dispensed with.

Fig. 1—Night View at Valley Center, Kan.

Another town to enjoy the benefits of electricity is Sedgwick, which has 750 inhabitants. A progressive blacksmith here uses a 5-hp motor to operate a trip-hammer, drill, saw and emery wheel, and has also two 1/6-hp forge blowers. Another 5-hp motor operates a laundry, all the work in which is done by means of electricity with the exception of the heating of water. The water is pumped, all machines run by motors, and electric irons are used exclusively. The two business streets of this little town form a "T," and a "white way" of twenty-four lamps, which are paid for by the merchants of the city, makes the street bright. Thirteen additional lamps maintained by the city are located in different parts of the town. Electricity has been available in Sedgwick longer than in Valley Center, and the leading merchants are lighting their places of business and residences are being wired. There are forty-five meters installed at present, and it is expected that 50 per cent of the houses in town will be using electricity shortly.

Fig. 2—Night View at Sedgwick, Kan.

In Halstead, a town of 1100 prosperous people, a franchise has been accepted by the company, and preparations are being rushed to set the poles and string wire. Over a dozen houses have been wired.

Even the farmers along the interurban line are inquiring about energy for light and motor service, before the company is able to take care of them. The time is not far distant when the entire country to the north of Wichita will be spanned by electric wires distributing energy from the largest central station in Kansas.

MOTOR-DRIVEN MILKING MACHINES.

By F. D. Burr.

Recent developments in Denver with motor-driven milking machines of the vacuum type are of considerable interest. Four dairies there have been equipped since December, 1911, and others have such installations under consideration. Machines of this type are said to have been in use for more than three years in Spokane and at other points on the Pacific coast, with satisfactory results. The following views and description are taken from the Manchester Dairy in Denver:

Fig. 1 shows a 2-hp, 220-volt, single-phase, 60-cycle motor running at a speed of 1710 r.p.m., which is belted to a rotary vacuum pump operating at 400 r.p.m. and maintaining a vacuum of 16 in. An electric motor is preferable to any other form of power on account of being noiseless. A pipe line is connected to the intake or suction end of the vacuum pump and extends through each barn over each row of stanchions, being attached to the posts against which the stanchions are built, as shown in Fig. 2. A pet-cock is connected to a vacuum pipe between each two cows. Thus a milking machine may be so attached that any cow,

or any number of cows at the same time, may be milked in any barn by using a rubber hose connecting the machine to the pet-cock.

The milk is collected in a 6-gal. tank shaped like an inverted milk pail. The milking is done by a set of four bell-shaped rubber cups, one longitudinal half of each bell being of hard rubber so that it will not collapse and the other half of soft rubber. Having 16 in. of vacuum inside

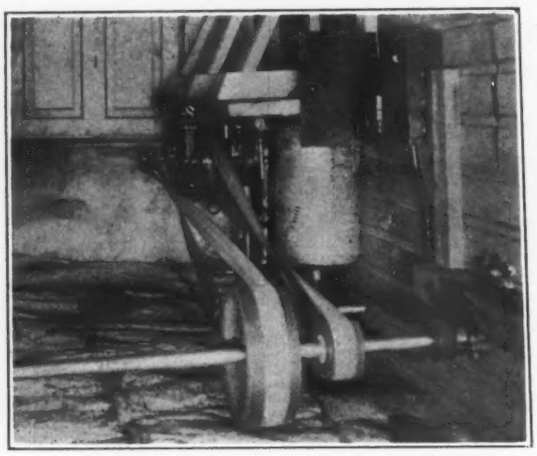


Fig. 1—2-hp, 220-Volt Motor Belted to Rotary Vacuum Pump.

(at the altitude of Denver, 1 mile above sea level), the normal atmosphere exerts a pressure of 7½ lb. per square inch against the outside of the teat cup, collapsing the soft rubber and squeezing the teat against the hard-rubber side. This is sufficient to give a gentle but firm pressure on the teat. A soft-rubber sleeve which has been vulcanized to the large end of the bell-shaped cup fits snugly over the teat to prevent air leaking in. When the cup is in position the bell hangs inverted with the point down. The milk runs to the point where a heavy rubber tube is connected by means of a small clear-glass funnel. The glass allows inspection of the milk and shows when the flow has ceased. The rubber tubes from each of the four cups are vulcanized into a larger tube through which the milk is drawn by the vacuum into the tank. As each machine milks two cows, the two main tubes, one from each set of cups, are connected a few inches from the tank by vulcanizing them into a larger tube which connects with a glass tube. The glass is convenient for inspection purposes and is fitted to the tank.

Advantage is taken of air pressure exhausting into a vacuum to operate an air engine built into the top of the tank; the engine valve admits atmospheric pressure and exhausts into the tank vacuum. The valve has a reciprocating motion in a vertical plane, and attached to it at right angles to the direction of motion is a pin which raises and lowers a second valve in the tube carrying milk from the two sets of cups. This latter valve admits air to the tube at each reciprocation of the engine for a very short part of the stroke, destroying the vacuum in the tube and cups and allowing the cups to expand momentarily. When the air port is closed by further travel of the valve the vacuum is again established in the tube and in each milking cup. The soft-rubber side of the cup again collapses from the outside pressure of air and thus eliminates the pulling and jerking of the hand milker. The vacuum draws the milk into the tank, where it is kept under cover until the tank is filled. The milk is thus never touched by human hands and is not exposed to the air, dust or dirt of the barns.

Fig. 2 shows two machines working and a third with cups and tubes in separate view. The number of pulsations per minute can be varied by adjusting a valve which increases or throttles the air admission, thus speeding up or slowing down the engine. Hard-milking cows require slower speed on the air engine, so that the vacuum is maintained for a longer period in the milking cup and the air pressure collapses the cup and squeezes the teat longer during each cycle of the valve. A speed as slow as fifty-four pulsations per minute is required for hard-milking cows, while easy milkers can be milked faster at seventy strokes of the valve per minute. All cows are thoroughly milked with this method. The pulsations are gentle, regular and even and tend to produce a free giving down of milk. The cows stand very quietly while the milking goes on. As two cows may be milked at one time with one machine, the hard milkers are paired off in order that the same speed may be used. Different sizes of cups are used so that any size of teat can be perfectly fitted, and the cows having teats of the same size are arranged to stand together in order to avoid, as much as possible, the loss of time by changing the cups. Of course the cows may be milked arranged in any order in any part of the barn. A two-machine outfit will milk twenty cows per hour, of average milkers, and save the expense of one man milking by hand.

The electric milking machine avoids the uncertainty and annoyance of losing hand milkers and having to hire new ones with different speeds and manner of milking. The milk yield drops off under frequent changing, as is well known, and the cows tend to hold up their milk until accustomed to the new conditions. One dairyman said in regard to the new method: "It improves the quality of the labor; it does away with the cheap, careless milkers and tenders, for I can afford now to pay good wages to steady, careful and skilled men." He also thought men trained in the dairy department of some reputable agricultural school could be profitably employed to take charge of dairies equipped for this method of milking.

This method of milking is said to lengthen the fresh life of the herd; the hard-milking cows are not dried up prematurely and instances where the machines have been in use for a year or more show that they increase the milk yield and improve the percentage of butter fat. The milk from herds where these machines have been used has been found to be most nutritive and sanitary for bottle-fed infants, which is a very important advantage.

The milk is next carried in the machines to the bottling room, where it is emptied into a tank whence it runs over a tubular cooler. A temperature of 35 deg. Fahr. is obtained within two minutes after the milk leaves the cow.

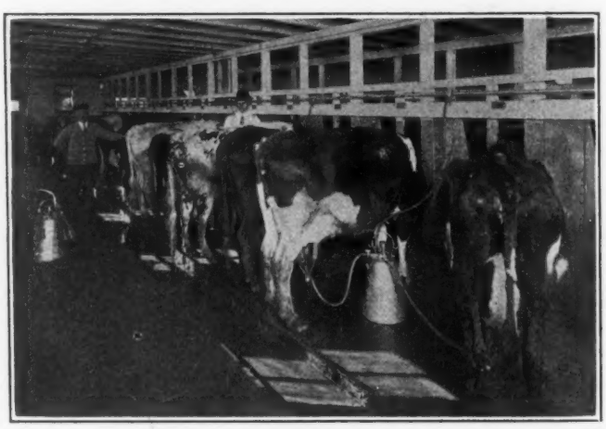


Fig. 2—Milking Machines in Operation.

It then goes immediately to the bottling machine and is sealed up in sterilized bottles, this operation being completed within five minutes after the cessation of milking, and then the milk is ready for the retail wagons, which start on their routes as soon as loaded.

The tubular cooler consists of twelve brass tubes, each 1 in. in diameter and 4 ft. long, arranged one above the other, ½ in. apart, in a vertical plane. Cold city water

flows through the upper six rows, while the lower six rows are traversed by brine which is supplied from a cooler and kept in circulation by a centrifugal pump belted to the countershaft shown in Fig. 1. The milk flows from the storage tank and falls upon the full length of the uppermost tube, and thence from tube to tube, until it has passed over them all.

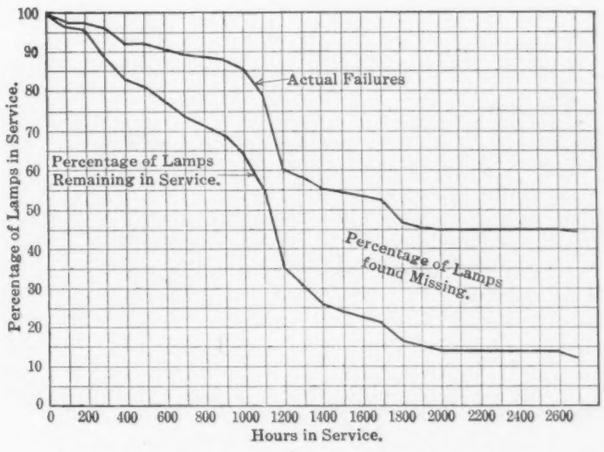
As soon as all of the cows have been milked the machines are thoroughly washed in hot water. The interior of the milking tubes and cups is thoroughly cleansed with washing powder and special brushes. They are then thoroughly rinsed in fresh hot water and kept in a clean place until needed again. The milking in most of the dairies is done between the hours of 1 a. m. and 5 a. m. and between 1 p. m. and 5 p. m., so that it is off-peak business and a desirable load for central stations.

Wiring and Illumination

SUCCESSFUL APPLICATION OF TUNGSTEN LAMPS IN RAILWAY WORK.

The great strides made by the lamp manufacturers in making a tungsten lamp against which the claim of fragility can no longer hold is well shown in the equipment of the express trains of the Interborough Rapid Transit Company's subway lines with lamps of this type. Indeed, the wire-drawn tungsten was chosen only after exhaustive tests in which its superiority over the graphitized-filament and tantalum lamps was conclusively demonstrated. For the purposes of the test 100 lamps of each of five types were purchased and installed on cars selected for the test, but operated in regular service. The types chosen had filaments of graphitized carbon, tantalum and tungsten. Each lamp socket in the test cars was numbered and all of the lamps were labeled when installed with the number of the socket and car and the date of installation. The lamps were inspected daily and all burned-out or broken lamps were recorded before being renewed.

From a study of the schedules and observations of the running time on open track during the daylight hours, the daily average time during which the lamps were in circuit



Test of Tungsten Lamps Used in New York Subway.

was estimated at eleven hours, and the life of the lamps was computed on this basis. The renewals were divided into two general classes, lamps burned out or otherwise defective and lamps accidentally broken or missing. The comparative life of the test lamps was calculated on the basis of the percentage of lamps still in service at the end of each 100 hours of burning. The ordinary rigid sockets with which the cars were originally equipped were used.

The tantalum lamps failed rapidly from the time they were first installed, as the filaments were quickly broken by the vibration. A similar result was obtained with the graphitized carbon-filament lamps. The wire-drawn tungsten-filament lamps gave the best results, the life of the lamps submitted by one manufacturer and of the make finally selected being shown in the accompanying curve. As will be noted, a few lamps with poor filaments failed soon after they were put in circuit, but about 65 per cent of the lamps gave a life of 1000 hours or longer. The failures increased rapidly after 1000 hours, although at the end of 2700 hours approximately 12 per cent of the lamps were still in serviceable condition.

When the tests had been continued far enough to permit of a fair comparison of the different types of lamps it was decided to adopt the tungsten lamp for the 780 subway express-train cars. The installation of these lamps was commenced last autumn and they have been in service ever since. While the tungsten is a more expensive lamp than either the tantalum or the graphitized carbon-filament lamp, better illumination is provided in the trains. The carbon lamp used heretofore gave excellent service so far as life was concerned, but gave insufficient light after 1400 hours' use. It was rated at 16 cp, 60 watts, while the tungsten lamp now used is rated at 32 cp, 40 watts. In the standard subway car there are twenty-six lamps in the interior of the car, two on each platform and two at each end in the lighted marker, making a total of thirty-four, of which only thirty are burning at one time. It is estimated that the saving in energy consumption is 6.6 kw-hr. a car a day.

DISCUSSION OF STREET AND INTERIOR LIGHTING AT BOSTON.

At the February meeting of the New England Section of the Illuminating Engineering Society, held at the Edison Building, Boston, with Prof. H. E. Clifford in the chair, a general discussion took place upon the subjects of interior lighting by so-called artificial daylight and of street lighting for "white way" illumination. A feature of the meeting was the illumination of the Edison auditorium by six magnetite, color-matching lamps of recent design, an exhibit also being made of a luminous arc lamp on an ornamental standard for city service. Considerable information of interest was also brought out in relation to the celebrated "white way" installation recently placed in operation at New Haven, Conn.

INTERIOR ILLUMINATION.

Mr. R. B. Hussey, Lynn, Mass., pointed out that the efficiency of equipment designed to permit color matching is too low at present for its use in general illumination. Restricted areas afford the best fields of service in this class of work. Mr. J. Cameron, Schenectady, N. Y., cited the effective use of the magnetite color-matching lamp in lithographic establishments and printing houses. He cited a department store in which two troughs of tungsten lamps are recessed on either side of a color-matching lamp, to enable customers to compare the appearance of dress goods under artificial light and artificial daylight. Other fields for this service are the textile, tobacco-grading and paint-manufacturing industries. Mr. H. W. Hillman, New Haven, Conn., called attention to the need of better electric lighting in art galleries and public libraries, where in many instances valuable works are being exhibited by the light cast from dirty metal reflectors with carbon frosted incandescent lamps. Mr. G. H. Stickney, Harrison, N. J., touched upon the possibilities of glass filters in connection with tungsten lamps. He said that more exact service is demanded in the dye room of a mill, particularly in silk or woolen manufacture, than in lithographic establishments. He felt that there is no excuse for exhibiting paintings by carbon lamps.

STREET LIGHTING FOR DISPLAY SERVICE.

Dr. Louis Bell, Boston, opened the discussion by a review of early street-lighting history, pointing out that modern requirements have passed far beyond the initial stage of police protection. The latest display lighting is a result of spontaneous efforts on the part of merchants to make the streets attractive by providing illumination in three directions. Mr. C. A. B. Halvorson, Jr., Lynn, Mass., reviewed the advantages of direct-current, series, ornamental luminous arc lamps for display service, including mounting on artistic columns and operation from constant-current transformers through rectifiers. Dignity, good color values and attractive daylight appearance are important features. Uniform distribution and white light of good quality were illustrated in the sample shown at the meeting, and the speaker said that a 520-watt lamp gives with a globe of medium density about 1000 cp at from 10 deg. to 20 deg. below the horizontal. The spherical globe was departed from on account of the need of avoiding the shadow cast by the electrode blocks and upper electrode, the benefit of a globe susceptible to architectural treatment being another point of importance.

In referring to the ornamental luminous-arc installation at New Haven, Mr. Halvorson said that it illuminates the façades of buildings even nine stories high fairly well. In a representative test the average illumination in the center of the street was 2.05 ft.-candles. On Chapel Street, New Haven, opposite the green, it was found that over 35 per cent lower average candle-power was obtained, due to the absence of a building on the green side to reflect the light. Mr. Halvorson said that the mechanism for feeding the electrodes in the New Haven lamps is like that used in the standard 6.6-amp magnetite lamps used in Boston. The problem of insulation received special attention on account of the possible application of 8000 volts on the circuit. The casing of the mechanism is supported between a 30,000-volt porcelain insulator and a second, as a result of which there is over 1.125 in. of jumping distance between the current-carrying parts and the casing. The top ornament housing the chimney is insulated. The posts are mounted on solid concrete 2.5 in. square and 18 in. deep, into which the bases are bolted. The lead-covered cable is brought in through a conduit and absolute cut-out located in the base. The lamp can be changed by removing three screws from the insulator. At New Haven the lamps are 14.5 ft. above the sidewalk. The illumination is much more efficient than where a 500-watt tungsten cluster is used. The illumination from the luminous lamp at 65 ft. equals that of a 5-lamp tungsten cluster at 35 ft.

Mr. H. W. Hillman, New Haven, said that seventy-five of these ornamental lamps are in use in that city and satisfactory service is conceded on all hands. A five-year contract has been made, operation covering an average of five hours per day throughout the year. The lamps are 88 ft. apart and staggered on opposite sides of the street, being 44 ft. apart alternately. The street width is 44 ft. and the pavement is of asphalt. The cost to the merchants is about 11 cents per front foot per month. The ornamental lighting campaign was an important factor in the general plan of "boosting" the city. On the opening night about 100,000 people were on the streets. President Mellen, of the New York, New Haven & Hartford Railroad, recently stated that many improvements in the architectural appearance of the new station to be built at New Haven have been planned, about $500,000 being appropriated above the original expenditure. Street widening to the station will be carried out by the city, and Mr. Hillman said that it was a matter for pride that the central-station industry is in a position to take care of the plans for illumination which are demanded by the project.

Mr. R. C. Ware, Cambridge, Mass., pointed out the possibilities of gas illumination for ornamental service. Mr. G. N. Chamberlain, Lynn, Mass., said that the effect of increased street lighting would be favorable to the use of more interior illumination. Mr. G. H. Stickney, Harrison, N. J., favored the single lamp rather than the group unit. He felt that the use of high-intensity illumination along flaming-arc lines is more or less of a failure. The more moderate units typified in New Haven do not tend to interfere with the proper display of merchandise by additional light sources. He spoke against tungsten clusters on account of the high absorption usually encountered at the globes. Mr. A. T. Sampson, Lynn, Mass., favored the use of yellowish light in street service. Mr. Hillman called attention to the fact that in a Western city sixteen merchants occupying second stories co-operated with the ground-floor interests and thus reduced the front-foot cost of ornamental lighting. He discredited the use of flame-arc lamps in service of this character. Mr. Halvorson also stated that tungsten clusters detract from the attention which should be paid to show windows. Mr. J. M. Dix, Schenectady, N. Y., was the last speaker. He brought out the point that the New Haven installation represents a marked advance in the supply of illumination in large amounts from a secondary source in no way disagreeable to passers-by on the streets.

INSPECTION OF ELECTRIC WIRING IN SPARSELY SETTLED DISTRICTS.

By W. J. Canada.

The success of either municipal or insurance inspection depends greatly on the degree of adherence obtained to the chosen standards. Municipalities of any size are under the double advantage of readily advertising their standards and, by means of frequent inspections and the licensing and bonding of wiremen, of insuring wholesome respect for the maintenance of the standards in new work and the rewiring of old work. Insurance inspection departments, on the other hand, may usually depend to a great extent on municipal inspectors where the latter have been created by ordinance. The underwriters' engineer will usually be able to secure the passage of a wiring ordinance without difficulty in any town of such size and growth that the inspection fees can be expected to amount to a considerable proportion of the municipal inspector's salary. The minimum size of town where a separate office of electrical inspector will be feasible is perhaps of 20,000 to 30,000 population, in the Eastern States, and as small as 10,000 to 15,000 in the Western States.

The municipal inspectors should receive the strongest moral support from the underwriters' inspector, because it has been found that this usually results in almost complete freedom from political interference and the adoption of a broader inspection plan than would otherwise be possible. Even in towns too small to support an electrical inspector as a separate officer, the adoption of a wiring ordinance should be obtained and its enforcement delegated to some existing officer whose duties and training most nearly fit him for such work. This official will usually be the fire chief, but might also be the city engineer with almost equal benefit. Occasional visits from the underwriters' inspector, and ready and thoughtful assistance through correspondence, will not only overcome many defects in the training of the local inspector, but will prevent him from falling into provincial methods and assuming a dogmatical attitude. The closer this relation the better will be the co-operation between underwriters and municipalities for many other important objects, such as proper building ordinances, fire department betterments, water-works improvements and the like.

Where communities are too small or insufficiently organized to afford any local wiring inspector, it is much better to have no ordinance. A law that for years has been a dead letter creates a local attitude of disrespect, which in

turn creates a considerable obstacle to efficient inspection when finally it is determined that the law must be enforced. The statute books often contain these unused and unrespected regulations, which gives rise to a general tendency to hold the law in diminished respect. When, in the course of time, the several states adopt statutes regulating wiring construction, as it would seem they must do in the near future, and undertake periodical inspections, with a system of penalties to enforce obedience of regulations, then the wiring problems of the small town, hamlet or isolated plant will be brought much nearer solution and definite standards will take the place of much of the inferior work which now exists.

Frequent visits to outlying communities of this character by the underwriters' electrical inspectors are prohibitive in expense, and no punitive measures can be applied by them to those wiremen, sometimes ignorant, sometimes designing, who make defective and dangerous installations. Worst of all, one such installation may set the local standard and establish prejudices which are removed with difficulty. The underwriters accomplish very much, even in the very sparsely settled Western territories, where they adopt an attitude of concern for the future of a wiring installation instead of merely criticising its defects at the time of inspection; the latter course possibly secures some minor improvements at once, but many of the defects come up again on the next insurance inspection a year or two later. Of course, it is the best policy to explain every fault in material, method or workmanship at considerable length and show clearly both how to eliminate the hazards observed and how to prevent their recurrence.

In order to lay wiring standards of a clear and simple character before the owners of buildings, it has been found helpful to supplement the National Electrical Code with brief rules for different classes of buildings. These may be made still more useful by suggestions for avoiding those common electrical hazards found the country over, such as the misuse of pendent cords and the improper use of brass-shell sockets in damp places or near grounded floors, piping or fixtures. The following rules have been found very useful by the author in accomplishing this purpose:

RULES FOR WIRING IN MERCANTILE BUILDINGS WHERE NO CONDUIT ORDINANCE IS IN EFFECT.

1. Service wires should be attached only to petticoat strain insulators on the outside of buildings.

2. Porcelain tubes should slant upward toward the inside, spaced at least 1 ft. apart, or preferably iron conduit with proper service head should be used to introduce service into building.

3. Main switch and cut-outs should be placed immediately at service entrance, and preferably on outside of building, so as thoroughly to protect all wires inside of building. If inside of building, they must be immediately on outside wall, with feeds directly entering back of cabinet, unless conduit is used.

4. Iron cabinets should be employed for all switches and cut-outs throughout building. Unless conduit is employed, wires should be bushed from last knob or cleat support into cabinet.

5. Mains, feeds and sub-feeds should be calculated according to Rule No. 18, page 31, of the National Electrical Code, reckoning 6 amp for each lamp circuit connected to such feeder, and reckoning 25 per cent over the capacity in amperes of all motors connected thereto.

6. Where the knob and tube construction is used, wires should be spaced at least 1 in. from surface wired over, supported every 4½ ft., and separated at least 5 in.

Where open wiring is used, either knobs or cleats may be employed, wires to be supported every 4½ ft. and separated at least 2½ in. Contacts on fittings should not be used as supports at end of runs.

7. Side-wall protection should be secured either by using double-braid rubber-covered wire in iron conduit from a point at least 6 ft. above floor to below floors, with suitable condulet terminals; or wires may be placed on knobs giving 1-in. spacing and protected by wooden boxing maintaining 1-in. spacing around wires and closed at the top, wires passing through top with proper porcelain or flexible tubing bushing; or wires may be run in ordinary iron pipe if separately protected from last knob support on either side of pipe by separate continuous lengths of flexible tubing.

8. Pendent cords should hang freely from their rosette supports. Portable cords should be approved reinforced portable cord.

9. In show windows conduit only should be used with proper fittings and terminals, except where there is no window inclosure and where lamps are at least 6½ ft. clear of window seat.

10. In basements, toilets and similar locations only porcelain or composition sockets should be used.

11. For direct-current motors feeds should be of size sufficient to carry safely 25 per cent more than normal ampere capacity of motor; with alternating-current motors feeds should have at least double the current-carrying capacity required by the normal motor full-load current and should in no case be over-fused.

12. Wires over 250 volts potential should be in all cases in conduit, and if over 500 volts in special construction.

13. For protection of interior wires against high-voltage entrance, alternating-current secondaries should be grounded in accordance with Rule No. 15b of the National Electrical Code.

14. All concealed wiring should be rubber-covered; open wiring either rubber-covered or slow-burning; conduit wire double-braided, joints cleaned, soldered and wrapped with rubber and friction tape. All fittings should be such as have been examined, tested and listed by the Underwriters' Laboratories.

RULES FOR WIRING IN REDUCTION MILLS.

Besides in all particulars complying with the requirements of the National Electrical Code, the following precautions are to be observed particularly:

1. Feeds to be protected immediately at service by main switch and cut-out for each building served.

2. All cut-outs throughout building to be in standard iron cabinets.

3. Service wires to be bushed into building with standard iron conduit extending to service cut-out cabinet and with proper conduit on outer end, or by porcelain tubes extending directly into such service cabinet.

4. In wet concentration or cyanide mills wires, where not run in completely standard iron-conduit construction, are to be on knobs with all sockets weather-proof, keyless, either porcelain or composition, circuits being controlled by snap switches on side walls, and drops where used to be soldered directly to circuit wires and supported independent of circuit wires.

5. Snap switches to be provided with porcelain sub-bases in open wiring.

6. Where wires run on side walls or posts within 6 ft. of floor or through floor, iron conduit to be used with double-braid rubber-covered wire and condulet at either end.

7. Live terminals not to be used as supports for wires, but knob support to be placed at least every 4½ ft.

8. In offices and similar locations ordinary cords and brass shell sockets may be used.

9. For portable lamps, reinforced portable cords and guarded hand lamps should be employed.

10. Joints throughout should be made mechanically secure and covered with both rubber and friction tape.

In the absence of governmental supervision, the various underwriters' associations, handicapped as they often are by an unfriendly political attitude, are nevertheless accomplishing excellent results in reducing the electrical fire

hazard in even the most thinly populated areas. Instead of giving the impression originally feared by the central stations, that electric wiring is a source of much mysterious danger, the result of close inspection has been to establish a sense of security among users which is not approached by any other type of illuminant. The electrical fire hazard has become a constantly lower proportional cause of fires, even in new territories and the less frequently inspected districts. Partially offsetting the closer inspection of older communities, there is more or less of a provincial attitude, which is noticeably absent in newer districts, where the adoption of proved methods recommended by inspectors is favored.

The inspector should be fairly acquainted with the physical and commercial problems of the various central stations in his territory and the closest co-operation should be sought from them by evidencing due appreciation of their position and objects. The life expectancy of buildings of various types of construction and the length of average tenancy should be considerations with the inspector, since all these points affect the initial investment which the owner or occupant is warranted in making. A knowledge of wiring materials and fittings must be kept up through close relations with supply houses and wiring contractors, supplemented by a constant study of general wiring experience and the statistics of electrical fire losses.

The label service of the Underwriters' Laboratories has proved of inestimable value in the standardization of products, and greatly aids the work of the inspector in numerous ways. The inspector is, of course, without equipment to carry on the work which the laboratories are now performing so satisfactorily.

The consistent support and aid of the local authorities is a great aid and almost a necessity to efficient inspection. The inspector should bear this always in mind, and through the exercise of tact seek to obtain and hold the confidence and co-operation of such officials.

RECENT TELEPHONE PATENTS.

SERVICE METER SYSTEMS.

With the advent of the message counter under normal control of the operator came the suggestion of the necessity for protection against duplicate scoring of calls on the one side and protection against failure to record on the other. It is this latter that is provided against in the invention of Mr. C. S. Winston, of Chicago, in a system recently patented by him. A third lamp is provided for each cord pair, that is, in addition to the usual supervisory lamps. The circuit of this third lamp is controlled by the calling subscriber. Thus, when he responds, as evidenced by his supervisory relay, the counter lamp glows until the operator records this successfully completed connection. The counter lamp is then locked out throughout the connection. Mr. Winston's patent is assigned to the Kellogg Switchboard & Supply Company. A service metering apparatus patented by Mr. Garrison Babcock, of Rochester, and assigned to the Telechronometer Company is of the automatic variety and furthermore includes an elapsed-time feature as well as the message counter. The metering devices are at the subscribers' premises and are of the polarized type. When the receiver hook rises a latch secured to it sets the pawl of the message counter. This counter operates upon a circuit controlled by the response of the called party. The elapsed-time register is actuated under control of a clock at the central. This clock causes a reversal of the current supply at stated intervals and the register follows these.

NEW MOUTHPIECES.

Messrs. C. H. Swingle and A. M. Miltenberg, of Chicago, are the joint inventors of a sound-intensifying mouthpiece. The shape is not far different from the standard, but a cone-shaped piece is mounted in the sound passage with apex outward. A space is left all around between the cone and the mouthpiece, the cone being supported upon a single central stud which rises from the perforated cross-partition. The parts are of metal, the mouthpiece bell, which is removable, being normally held by a friction clamp at the line of the cross-partition.

The mouthpiece patented by Mr. W. W. Woodruff, of Canton, Miss., is designed with a special view of retaining an antiseptic. A collar screws into the transmitter face which carries the cross-partition. An annular flange rises from the collar, the outer surface being threaded. The mouthpiece bell has a double wall with a space between into which the flange screws. The fit is such that the sound passage presents a smooth bore. The space between the walls of the mouthpiece not occupied by the flange is filled with absorbent, which is soaked in antiseptic solution, the fumes of which are admitted through perforations in the inner wall.

Letters to the Editor

ELECTRICAL METHOD OF DETERMINING RECALESCENCE POINTS.

To the Editor of Electrical World:

Sir:—Referring to the letter of Dr. Karl Georg Frank, appearing in your issue of April 13, I beg to say that the double-reflecting galvanometer described in your issue of March 16, page 604, was developed by the writer in the laboratories of Siemens & Halske, A. G., Berlin. I am sorry that your printer left out the name of the distributing firm, which appeared on the proof.

New York. A. Schramm.

MAINTENANCE OF ORNAMENTAL POST LAMPS.

To the Editor of Electrical World:

Sir:—The system of lighting business streets by means of lamps on ornamental iron posts at frequent intervals has spread with remarkable rapidity, and while installations of this kind are to be found in all parts of the country, doubtless the greatest activity is in the country tributary to St. Paul and Minneapolis, in which the development has reached a stage where numerous towns of less than 5000 inhabitants have taken up the matter. In fact, no town in that locality of 5000 inhabitants or more without such a system can now be considered up to date.

It seems proper at this stage of the development of this kind of business to utter a word of caution as to its future. If this system is to remain popular and is to be maintained by merchants or the public after the novelty wears off, it is very important that the lamps and globes be properly cleaned and maintained. In some places where this system has been installed lack of proper maintenance is quite evident. Globes are allowed to collect dirt. Burned-out lamps are not renewed. Occasionally a globe will be missing altogether. Now, an ornamental system of street lighting of this kind is anything but ornamental if not properly maintained. Unfortunately, in some cases the maintenance of these ornamental systems is not in the hands of the central-station company and is therefore not as likely to be looked after in a systematic manner as if it were done by contract. Even if the central-station company is not inclined to live up to its contract to maintain these lamps properly, the protests of the property owners will soon force it to do so; but if the property owners are depended upon to do it themselves or through some hired representative, the matter is much less likely to be looked after closely.

Chicago, Ill. S. M. Gorgas.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Single-Phase Commutator Motors.—Paul Müller.—The conclusion of his paper read before the Dresden Electrical Society on single-phase commutator motors of the Bergmann Company. The critical comparison of the series and repulsion motor leads the author to the conclusion that the only real advantage of the repulsion motor is speed regulation by displacement of the brushes. The company has developed a kind of combined series-repulsion motor. To compensate exactly the commutation emf (which is produced in the short-circuited armature coils by the reversal of the current) use is made of a peculiar kind of compensation winding. It consists in general of from three to five coils per pole. Heretofore these were connected always in series. In the new arrangement, however, these coils are connected in parallel and the numbers of the turns of the coils are calculated from certain rules.—*Elek. Zeit.*, March 28, 1912.

Dynamo Design.—A. E. Clayton.—The conclusion of his mathematical paper on the design of dynamo-electric machinery in which he deals with the design of dynamo-electric machines from the point of view appertaining to the individual pole group.—London *Electrician*, March 29, 1912.

Cooling Devices for Dynamos.—Karl Czeija.—The first part of an article illustrated by numerous diagrams showing the evolution of cooling arrangements for high-speed dynamos. The article is to be concluded.—*Elek. Zeit.*, March 28, 1912.

Voltage Drop of Transformers.—H. Engel.—The author gives a diagram for the determination of the voltage drop for various phase differences in a transformer. The diagram is quite similar to the diagrams of Hunzinger and Hahnemann, but is derived by the author in a simpler manner.—*Elek. Zeit.*, March 28, 1912.

Measurement of Slip.—W. Angermann.—A translation of his recent German paper on the measurement of the slip of induction motors, the method being based on the fact that the filament of a lamp supplied with alternating current vibrates if placed in a constant magnetic field.—London *Electrician*, March 29, 1912.

Lamps and Lighting.

The Thomson Effect in and the Thermal Conductivities of Tungsten, Tantalum and Carbon at Glowing Temperatures.—A. G. Worthing.—An abstract of an American Physical Society paper. In the investigation of the losses in incandescent lamps due to the cooling effects of the supports and the leading-in wires a variation was noticed which was ascribed to the Thomson effect. The suggestion was made by Hyde at that time that the same method might be used to study the Thomson effect. This has been done. The method of observation is the same as before. The observations consist essentially in the determination by an optical pyrometric method, in the case of an incandescent lamp, of the time rate of energy radiation per unit of length for elements of filament in the neighborhood of a support or leading-in wire as a function of their distances from the support or leading-in wire, (a) when the current through the element of filament is flowing toward the cooling support; (b) when in the opposite direction. The difference between these two quantities is in part due to the Thomson effect. From the results so obtained the Thomson effect and the ratio of thermal conductivity to the electric conductivity may be calculated by means of formulas given in the paper. Some of the results are shown here in the tables. When these results, together with some thermoelectric results on tungsten and tantalum by Coblentz are handled thermodynamically, it is found that a tungsten-tantalum thermocouple at high temperatures is about four times as sensitive as a platinum-platinum rhodium thermocouple. It is evident that the Peltier emf between two metals may be measured by a method similar to the foregoing. All that is essential is to determine the change in the rate of heat conduction along a filament composed of the two metals welded together, in passing from one side of the junction to the other. Such measurements are contemplated.—*Physical Review*, February, 1912.

COEFFICIENTS OF THOMSON EFFECT IN MICROVOLTS PER DEGREE.

Absolute Temperature, Degrees.	Tungsten.	Tantalum.	Carbon
1,600	16	−5	−20
1,800	22	−6	−20
2,000	29	−8	−20
2,100	33	−9	−20

$10^{-10} \times$ THERMAL CONDUCTIVITY $\div$ ELECTRICAL CONDUCTIVITY, IN C.G.S. ELECTROMAGNETIC UNITS.

Absolute Temperature, Degrees.	Tungsten.	Tantalum.	Carbon
1,600	56	27	280
1,800	73	33	270
2,000	94	46	260
2,100	103	56	240

Illumination of Printing Works.—Two papers presented before the British Illuminating Engineering Society. One, by J. Eck. deals with the illumination of printing works by electricity; the other, by F. W. Goodenough, with the illumination of printing works by gas.—London *Electrician*, March 29, 1912.

Installations, Systems and Appliances.

German Electrical Industry.—A continuation of the long statistical review. In concluding the discussion of the general present commercial situation in Germany the very high taxes which the industries of Germany have to bear are pointed out. The taxes, including the expenses for obligatory workingmen's insurance, amounted in 1909 to 3.5 per cent of the invested capital and to 39 per cent of the dividends. The electrical industry is then considered in detail and a large table is given of the German electrical import and export trade. While the amount of exports is satisfactory, the prices received in the export trade have not been as satisfactory. The number of working people in January, 1911, was 64,016 (against 59,163 the year before). Of these, 50,643 were men and 13,373 were women, so that the number of workingmen was 3.8 times the number of workingwomen. The article is to be continued.—*Elek. Zeit.*, March 28, 1912.

Increasing the Sales of Energy from Central Stations.—E. Wikander.—A report made before the Berlin Electrical Society on means of increasing the sale of electrical energy from central stations. The following methods are considered: Free or partially free installation (including the Gothenburg free-for-one-year system, which was recently described in the *Digest*); the introduction of new method of charging for electrical energy; reduction of the meter rent; solicitation and advertising propaganda; rent and sale of electrical apparatus under an instalment plan. Finally the central-station manager should be given a free hand.—*Elek. Zeit.*, March 28, 1912.

Wires, Wiring and Conduits.

High-Tension Porcelain Line Insulators.—J. Lustgarten.—A paper read before the Manchester section of the (British) Institution of Electrical Engineers. The author after discussing the properties of electrical porcelain goes on to deal with the various forms of pin and suspension insulators, the considerations that arise in their design and their general operating features. The testing of the insulators is also dealt with.—London *Electrician,* March 29, 1912.

Overhead-Line Construction.—F. Suechting.—An illustrated description of a new method of overhead-line construction in city streets where esthetic considerations are of importance. There are no poles used, but span wires are stretched across the street and the conductor lines are suspended from the span wires.—*Elek. Zeit.,* March 28, 1912.

Electrophysics and Magnetism.

Stratification and Capacity of Carborundum.—George W. Pierce and Rhys D. Evans.—An article giving an account of an experimental investigation in which the authors find that a fragment of carborundum, with certain attachments of the electrodes, shows a large electrostatic capacity. Measurements are given of this capacity in two typical cases. The capacity measurements with two specimens are given for different voltages and different frequencies of charge and discharge. The capacity of one of the specimens was about 0.006 mf; that of the other about 0.022 mf. The discussion of the measurements is followed by an account of a microscopic and electrical investigation of the carborundum, which shows that the carborundum crystal is made up of an insulating mass permeated by fine layers of conducting material. These conducting layers are nearly parallel, and, separated as they are in the crystal by non-conducting sheets, form a natural electrical condenser, provided electrical contacts are made to two conducting layers that do not happen to short-circuit within the crystal. So far as the present experiments show, the action of the carborundum as a detector for electric waves and as a rectifier for electric currents is independent of its action as a capacity. But it will detect electric waves or rectify only provided contact is made to one or more of the conducting strata. It may detect electric waves with an adjustment that shows no capacity by the present method of measuring capacity. On the other hand, with every adjustment at which the authors found capacity they found also rectification and detection of electric waves.—*Proceedings Amer. Academy of Arts and Sciences,* Vol. 47, No. 21, March, 1912.

Electric Currents from Carbon at High Temperatures.—J. A. Harker.—In the course of some electrical furnace experiments the author made the following observation. If two electrodes are placed in the furnace without being connected to a source of energy but connected with an ammeter on the outside, the ammeter will show a current when the two electrodes are at places of different temperatures in the furnace. By making one electrode movable and using some periodic device for moving the electrode to and fro it is possible to produce an alternating current of very low frequency. Another experiment was as follows: Instead of two electrodes two coaxial tubes are used mounted within the furnace. Brass is used for the central smaller tube, through which a rapid current of water is sent; this forms the "cold" electrode. The surrounding larger tube of carbon constitutes the hot electrode and receives its heat from the furnace. The electrodes are insulated, and into the annular space between them hydrogen or nitrogen is continually passed. No potential is applied, but currents are again obtained, which change in a particular way shown in a diagram while the temperature of the furnace is gradually raised. On taking down the apparatus after such an experiment the authors found that the brass tube was coated over most of its length with a thick and coherent deposit of carbon which had evidently crossed over from the hot electrode.—London *Electrician,* March 22, 1912.

Thermal Insulation of Furnace Walls.—Carl Hering.—An article in which the author briefly summarizes the salient features and conclusions reached by him in former papers as to the best way of calculating the heat loss through furnace walls and interpreting the results. He recommends the use of thermal resistances and resistivities instead of conductances and conductivities and to use the thermal ohm as the fundamental unit.—*Met. and Chem. Eng'ing,* February, 1912.

Origin of Radium.—F. Soddy.—A paper presented before the Royal Institution in London on his long-continued experimental attempts to trace the growth of radium from uranium. His main results were negative. Some slight indirect evidence of uranium as the primary parent of radium was obtained, but the extremely slow growth of radium suggests the existence of an intermediate product between uranium and radium, which is probably ionium. This is chemically identical both with uranium *X* and with thorium.—London *Electrician,* March 22, 1912.

Magnetic Rotation and Ellipticity.—Paul D. Foote.—An account of an experimental investigation in which the magnetic rotation and ellipticity by reflection at normal incidence have been measured throughout the visible spectrum for massive mirrors of iron, cobalt, nickel, steel, invar, magnetite and Heusler's alloy. The ellipticity, the investigation of which was the main object of the work, and which has not been studied extensively by other observers, was found to be consistent with what might be expected from the work which had been done in transmission. For the majority of substances tested it was negative throughout, but for others it changed sign within the visible spectrum. As with transmitted light, the ellipticity of the reflected light in every case was found proportional to the intensity of magnetization for all wave-lengths.—*Phys. Rev.,* February, 1912.

Law of Induction.—F. Emde.—A mathematical note with reference to a recent article by Jenkin on the meaning of a certain function in Maxwell's formula for the law of induction.—London *Electrician,* March 22, 1912.

Electrochemistry and Batteries.

Electric Resistivity and Polarization Emf of a Mixture of Clay, Feldspar and Quartz.—A. A. Somerville and O. E. Buckley.—An abstract of a Physical Society paper. Pottery samples containing English ball clay, feldspar and quartz were molded in the form of rods about 1 cm in diameter and 3 cm to 5 cm in length and baked at a temperature of 1100 deg. C. Electrical connections were made by passing nickel wires through holes near each end of a rod. Such a piece of pottery is an insulator at ordinary temperatures, but becomes a conductor at higher temperatures. It does not follow the most simple form of Ohm's law, $I = E/R$, but, owing to something like a polarization effect, this becomes a conductor to which the form of the equation, $I = (E - e)/R$, is applicable. R is measured and e is eliminated by using an alternating-current device, a sechometer, in connection with a dry cell and Wheatstone bridge. Temperatures are measured by means of a platinum resistance thermometer and indicated on an automatic recorder. The heating is accomplished by means of a tubular resistance furnace. The resistance of one of these rods of pottery behaves much like that of glass, porcelain, quartz and the Nernst glower. It is 10,000,000 ohms at about 550 deg. C. and decreases rapidly as the temperature increases until at 1100 deg. C. it measures approximately 15,000 ohms. When a direct current is passed through a piece of the pottery a polarization or counter emf is produced which is represented in the above equation by e The specimen is charged for a given time, at a definite temperature, by a certain voltage. A switch is then thrown

to connect it into a potentiometer circuit and a balance is obtained giving the value of e as quickly as possible, usually after only a few seconds. The time-decay curve of e is then determined. During the whole experiment the piece of pottery is suspended by means of its lead wires in the furnace. Nickel leads have been used. It is found that e is a function of the charging voltage, time of charging and temperature. It increases rapidly as the charging voltage goes up to about 6 volts or 8 volts and then slowly as the latter moves up to 110 volts. It increases with time rapidly for about two minutes and thereafter slowly. It decreases as the temperature increases. The maximum polarization or counter emf obtained is about 2 volts. The rate of discharge is dependent on temperature, time of charging, and material and size of electrodes, leads or connectors used. The rate of discharge increases as the temperature increases and decreases as the time of charging increases. The rate of discharge also decreases as the size or number of nickel wires used as leads is increased. If nichrome is used, the e obtained is the same as for nickel, but in the case of the alloy the decay or discharge is much more rapid. If iron leads are used, the e obtained is slightly higher than is the case when using nickel and the discharge is also more rapid. —*Physic. Rev.*, February, 1912.

Pinch-Effect Furnace.—Carl Hering.—A note stating that recent tests have shown that practically no wearing away takes place of the resistor tubes (made of a special form of magnesite) in a pinch-effect furnace due to the flow of heated metal.—*Met. and Chem. Eng'ing*, April, 1912.

Volume Changes in Storage Battery Electrodes.—C. Toone.—The author first notes Schoop's method in which the weight changes in accumulator plates on charge and discharge may be studied directly by the aid of a balance. He then describes a new method of H. Hobel, which is an adaptation of the Poggendorf-Gauss mirror method to the direct observation of the working changes in the volume of accumulator plates by determining their change in height. This method is applicable to the comparison of pasting and "forming" methods, and appears to be quite suitable for the rapid testing of new types of accumulators.—London *Elec. Review*, March 22, 1912.

Electrolytic Detinning.—A description of three Italian plants in which metallic tin is recovered from tin sheet scrap by an electrolytic process. A sodium hydrate solution is used with the tin sheet scrap in baskets as anodes and iron plates as cathodes.—*Met. and Chem. Eng'ing*, April, 1912.

Storage Batteries.—H. Beckmann.—His Turin Congress paper deals with the present status of the technics of stationary storage batteries and of storage batteries for automobiles and for general traction purposes.—*L'Electricien*, March 16 and 23, 1912.

Aluminum.—G. Flusin.—A statistical article on the production of aluminum in the world, with a list of the chief companies producing aluminum in different countries.—*La Lumière Elec.*, March 23, 1912.

Liquefied Gas Cells.—A. Berthier.—The first part of an article on the possibilities of the direct transformation of the calorific energy of fuel into electrical energy. While heretofore experiments have been made chiefly with aqueous solutions, the author proposes to investigate the possibilities of the use of other liquids than water and especially of liquefied gases.—*La Lumière Elec.*, March 23, 1912.

Units, Measurements and Instruments.

British National Physical Laboratory.—The first part of an account of the work at the (British) National Physical Laboratory in 1911. A new optical building and a building for metallurgy are in course of erection. F. E. Smith has made during the year a large number of preliminary experiments with the Lorenz apparatus leading to certain modifications in detail, which may materially increase the accuracy of the measurements. The co-operative work in continuation of researches carried out in 1910 at the Bureau of Standards at Washington has been continued, with the object of completing the international specifications for the silver voltameter. Some experiments have been made by Campbell in the construction of mutual inductances with temperature compensation. Methods of comparison of resistance with mutual inductance have been employed for the derivation of the value of the ohm in absolute units. Comparative tests of total energy and hysteresis loss in iron sheets have been made with the co-operation of the Bureau of Standards and of the Reichsanstalt. The results obtained in the three laboratories are in satisfactory agreement. An investigation by Raynor shows that under certain circumstances the long-continued application of a lower pressure may be much more deleterious to insulation than a higher pressure acting for a shorter time. The following numbers of tests were made in 1911, the figures in parentheses being the numbers of tests in the preceding year, 1910: In 1911 there were made 269 "electric measurements" (against 172 in 1910), 2203 (1810) "electrotechnical" tests, 920 (480) photometric tests, 582 (496) thermometric tests, 5106 (5308) optical tests, 2974 (1860) meteorological tests, 17,665 (18,366) taximeter tests, 283 (159) tests in the engineering department, five tests in the new "national tank," and 37,145 (36,395) tests in the observatory department. An account is given of the work proposed for the year 1912. The chief work to be completed as regards the fundamental units is the determination of the ohm. Further experiments with the Ayrton-Jones current weigher will be made. In continuation of the co-operative work with the standardizing laboratories of America, France and Germany comparisons of the new mercury standards of resistance and of standards of emf will be made. It is proposed to make such further experiments on standard cells and on the silver voltameter as are suggested by the work of the Washington technical committee. The results of the co-operative experiments should enable the international specifications to be completed. Improvements will be made in the apparatus for the production of high-frequency oscillations and in the construction of inductances and condensers. In the magnetic work it is proposed to investigate a new method of testing iron rods and strips. The power-factors of standard condensers and their variations with frequency will be further investigated. A subdivided series transformer for the measurement of small currents will be completed and its behavior investigated. Work will be continued in 1912 with a view to insuring still further the constancy and the uniformity of the common unit of candle-power used in Great Britain, France and America. Work is particularly wanted in the direction of ascertaining the order of agreement which results from the different methods which are used for standardizing high-efficiency lamps in terms of the unit of candle-power, and international comparisons are on foot and in contemplation with this end in view. The investigation of the personal differences which arise when lights of different colors are being compared will be continued. The report is to be concluded.—London *Electrician*, March 22, 1912.

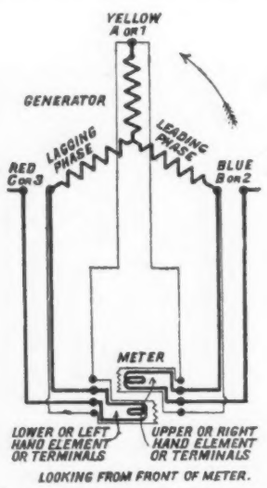
Formulas and Tables for the Calculations of Mutual and Self-Inductance.—Edward B. Rosa and F. W. Grover.—A long treatise of 237 pages, in which the authors have brought together all the formulas which are of value in the calculation of mutual inductance and self-inductance, particularly in non-magnetic circuits when the frequency of the current is low enough to assure sensibly uniform distribution of current. Where several formulas are applicable to the same case, the especial advantage of each is pointed out and it is indicated which is best adapted to precision work. There are ten chapters: Mutual inductance of two coaxial circles; mutual inductance of two coaxial coils; mutual inductance of coaxial solenoids; mutual inductance of a circle and a coaxial single-layer coil; the self-inductance of a

circular ring of circular section; the self-inductance of a single-layer coil or solenoid; the self-inductance of a circular coil of rectangular section; self and mutual inductance of linear conductors; formulas for geometrical and arithmetical mean distances; high-frequency formulas and examples. An appendix gives tables of constants and functions useful in the calculation of mutual inductance and self-inductance—*Bulletin Bureau of Standards,* Vol. VIII, No. 1, Jan. 1, 1912.

Radiation Pyrometry.—G. A. Shook.—The first part of a series of articles on radiation pyrometry. In the present instalment the author discusses the principle of temperature scales and the loss of radiation, especially the total radiation law and the law for the distribution of the energy radiation in the spectrum.—*Met. and Chem. Eng'ing,* April, 1912.

Effect of Direct Currents and Alternating Currents on Insulators.—A note on tests made by Laporte, de la Gorge and Girault on the behavior of the insulating media used for cables, with direct currents and alternating currents, and with alternating currents of low and high frequencies. It appears that, although alternating currents break down the insulation much more readily than direct currents, the ratio between the voltage in each case necessary to cause a break-down varies with the material used. In the case of dry paper, for example, this ratio is 1 to 1.8; with caoutchouc it is 1:2.6; well-insulated cellulose gives the ratio 1:3.2, and air gives the ratio 1:1.1. In certain cases glass gives the ratio 1:6.3, so that with glass insulation direct current would require less than one-sixth of the insulating medium that would be necessary in the case of alternating current. As regards the influence of the number of alternations per second on the breaking-down voltage of various dielectrics, the following figures show the ratio of those voltages for currents whose frequencies are respectively 25 and 500: Glass, 1.45; presspahn, 1.42; ebonitem, 1.23; mica, 1.18; oil, 0.92, and air, 0.95. The figures show that higher numbers of alterations increase the stress on the dielectric, except in the case of oils and gases.—London *Electrician,* March 22, 1912.

Three-Phase Meter Connections.—In last year's report of the British National Physical Laboratory it is stated that difficulties have frequently arisen in the use of two-element, three-phase watt-hour meters on account of differences



Three-Phase Meter Connection.

which take place in the rate of the meter according to which element is connected to the leading and which to the lagging phase of the system. British manufacturers of three-phase meters have been consulted with a view to securing a uniform system of marking or coloring meter phases, so that in the connecting up of meters there shall be no doubt as to how the elements are to be connected to the system. The connections agreed upon are shown above.—London *Electrician,* March 29, 1912.

Power-Factor and Conductivity of Dielectrics.—J. A. Fleming and G. B. Dyke.—An illustrated paper on the power-factor and conductivity of dielectrics when tested with alternating currents of telephonic frequency at various temperatures. In the first part of this paper Fleming discusses the conductance of dielectrics to alternating currents and suggests an arrangement of non-absorptive condensers and resistances which imitates the phenomena exhibited by condensers whose dielectrics possess absorption and residual charge characteristics. He also discusses the application of the electron theory to dielectric conduction. In the second part of the paper a series of experiments are described for determining the conductivity of various dielectrics, and the results are summarized in tables.—London *Electrician,* March 29, 1912.

Operating Cost of Telephone Exchanges.—C. L. van der Bilt.—A statistical article giving data on the cost of operation of the telephone exchanges in Haag, Rotterdam and Amsterdam. It is emphasized that to get a satisfactory basis of comparison, the costs per call should be compared. —*Elek. Zeit.,* March 28, 1912.

Book Review

Principles of Electrical Engineering. By Harold Pender, Ph.D. New York: McGraw-Hill Book Company. 438 pages, 136 illus. Price, $4.

The present is the first completed edition of a treatise the preliminary edition of which was reviewed on page 935 of our issue for April 13, 1911. Certain sections of the book have been rearranged and more fully developed, and examples have been added in each chapter for the purpose of illustrating the principles discussed and summarized at the end of the chapter. The general character of the treatise has not been altered, and hence the review of the earlier edition applies to this edition also.

In no respect has the author attempted to avoid the use of calculus; neither has he made any attempt to employ calculus where its use is not fully justified by the interrelations of the phenomena being discussed. As a matter of fact the book represents one of the best examples of the proper use of calculus as the logical mathematical tool for assisting in simplifying the problems encountered in electrical engineering calculations. Dr. Pender has done excellent work in showing that calculus can be employed, and should be employed, as a labor-saving device for the reader as well as for the writer, which latter result seems to have been the only one considered by the large majority of writers who have used this shorthand method of representing physical relations.

To an extent that will appeal strongly to all readers of the book and all persons who will use it for instructional purposes, Dr. Pender has explained fully the exact physical relations represented by each mathematical equation and has accompanied each mathematical transformation with a clear statement of its physical significance. The subjects treated in this excellent manner include electrostatic, electromagnetic, continuous-current and alternating-current phenomena. One of the nine chapers is devoted to the symbolic method of representing vectors in alternating-current problems, while the concluding chapter contains a discussion of the application of this method to problems relating to three-phase circuits. The book can be recommended highly for the person who is familiar with calculus and wishes to apply his knowledge in acquiring information quickly concerning electromagnetic phenomena, for the person familiar with electromagnetic phenomena who wishes to learn how to apply calculus most simply in engineering problems, and for the person who wishes to acquire simultaneously accurate information concerning electrical engineering relations and the logical application of calculus in engineering.

New Apparatus and Appliances

APPLICATION OF CABLE CLAMPS.

The accompanying illustrations show the application of the cable clamp manufactured by W. N. Matthews & Brother, St. Louis, Mo., to overhead-line work in Mobile, Ala. The cross-section of the cable shown in Fig. 1 is

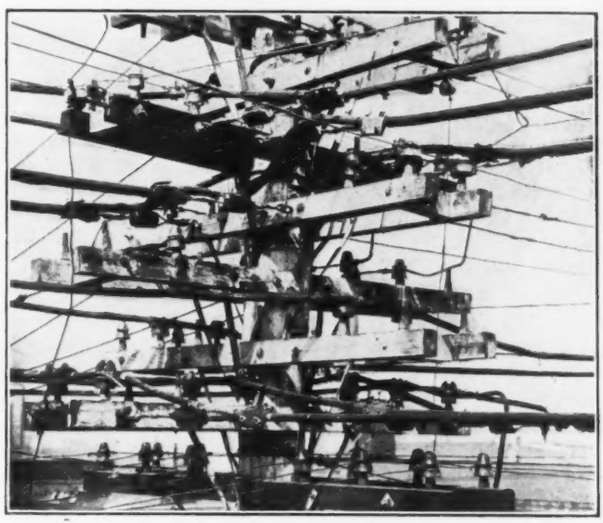


Fig. 1—Application of Cable Clamps.

500,000 circ. mil, and the largest wire shown on the second arm from the top, not counting the buck arm, has a cross-section of 1,000,000 circ. mil. As will be inferred from the illustration, the pole is located in a crowded corner, and it would be practically impossible to hold the wires in any kind of position without employing for this purpose some form of clamp.

All of the other wires shown in the illustration and held by clamps are of 500,000-circ. mil cross-section. Porcelain insulators are used in this work, strain insulators having been found unreliable in that locality after a number of

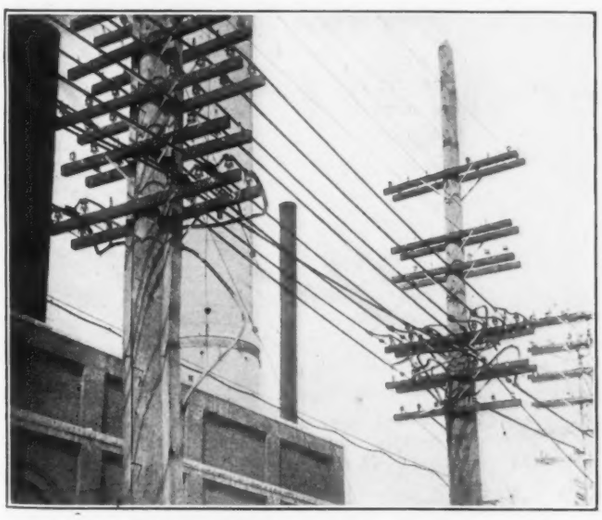
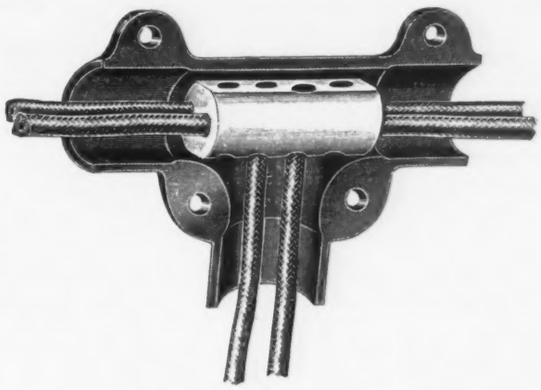


Fig. 2—Application of Cable Clamps.

years of use. Fig. 2 is a view of poles in front of the station of the Mobile Electric Company, and also shows the application of the clamp, the construction of which is evident from the engravings.

PORCELAIN CONNECTOR.

The accompanying illustration shows a convenient form of T connection which the Simplex Conduits, Ltd., Garrison Lane, Birmingham, England, has brought out. The connector fits into a standard ¾-in. split T-piece and is intended for making connections between small wires. It can also be used in all of the company's circular boxes. Several other forms of porcelain specialties for making connections are supplied for taking branches to a switch point or a lamp point. The terminals in these are so arranged that it is not necessary to cut the main wires.



Porcelain Connector.

The wire is bared of insulation for about ½ in., and the conductor thus exposed is dropped into the slots in the terminal provided and then clamped by a screw ring.

LARGE ELECTRIC-RAILWAY SIGN IN ST. LOUIS.

The Illinois Traction System has installed the large and striking electric sign illustrated herewith over its St. Louis

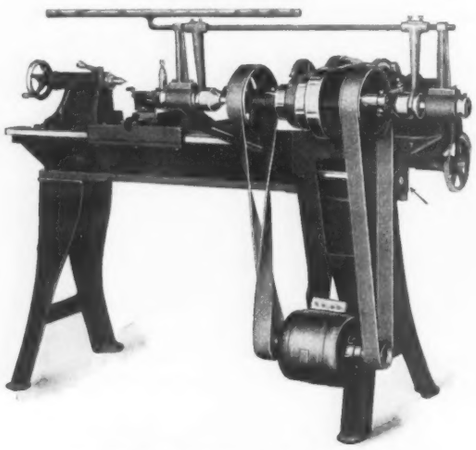
Electric Sign in St. Louis.

passenger station. The sign is 22 ft. 6 in. wide and 51 ft. high and is made up of 1962 5-watt tungsten lamps mounted on a structural steel frame. It is elevated about 8 ft. above the terminal station roof at the corner of Twelfth Street

and Lucas Avenue, as shown in the picture, and the top of the sign is about 100 ft. above the sidewalk. It has been placed in such a position that it may be read from a distance of eight blocks down Twelfth Street, an important thoroughfare in St. Louis. By a flashing device an interurban car is shown with wheels turning as the track passes under them, giving the effect of a moving car. The signal used is typical of the block signals installed on the Illinois Traction System and the semaphore arm is flashed in the "proceed" and "stop" positions. When the blade is in the "proceed" position the car appears to move at high speed, and when the blade takes the "stop" position the wheels of the car cease to revolve and the car remains apparently in a stationary position, thus giving the effect of a stoppage at signal. The sign is attracting considerable attention on account of its size and conspicuous position. It was designed and erected by the Federal Sign System (Electric) of Chicago, under the general supervision of H. E. Chubbuck, vice-president executive Illinois Traction System.

DOUBLE-DRIVE METHOD OF OPERATING LATHE.

By the O'Brien double-belt reversible-drive method, illustrated herewith, a lathe can be operated by electric motor for direct or reverse drive in a simple and practical manner. A cast-iron bracket carrying both the countershaft



Double-Drive Method of Operating Lathe.

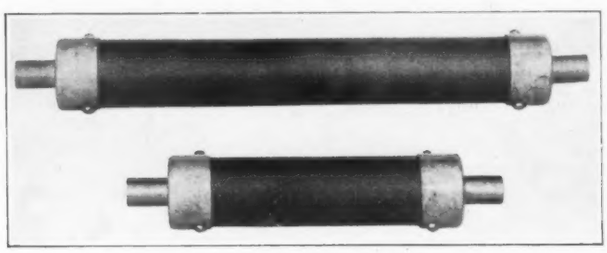
and the motor is pivoted to a casting attached to the lathe bed, as shown by the arrow in the picture. This bracket is adjustable as a belt tightener between the countershaft and the spindle cones. Adjustment is made from a screw in front of the lathe within easy reach of the operator, and the belt may be tightened while the lathe is running. A simple adjustment on the base of the motor permits further tightening of belts from motor to countershaft. As the complete countershaft is attached to the pivoted bracket, the starting, stopping and reversing of the lathe and the variations of speed are obtained through the countershaft in the usual way, as though the countershaft were attached to the ceiling. This is made possible by the reverse belt on the motor, which gives the double drive. Thus a constant-speed motor may be used, and no reduction gear, reversing motor or variable-speed motor is needed. Any regular stock motor may be used, with the shaft extended and a pulley at each end.

Complete control of the lathe is had by the operator by the use of the horizontal shipping bar shown in the illustration. This bar varies with the length of the lathe used, and by it the machine is started, stopped and reversed. If reverse drive is not used, the crossed belt may be removed. A knife switch may be placed at any convenient position on the lathe and may be inclosed in a sheet-metal box if desired. A starting box is not necessary, as the throwing of the knife switch starts the countershaft friction pulleys only, which are running loose on the shaft. This method of drive is a distinct unit attached to the regular stock lathe made by the South Bend Machine Tool Company, of South Bend, Ind., which is the manufacturer of the O'Brien double-drive method. The motor drive may be equipped at the factory at the time of the purchase of the lathe or may be attached at any time afterward in the user's shop. The customer may furnish the motor or the manufacturer will supply it. Any constant-speed motor for alternating or direct current having a speed of 900, 1200 or 1800 r.p.m. will serve. The armature shaft, of course, must be long enough for a pulley on each end.

It has been found that this method of electric drive may be used for other purposes than the running of lathes. One man has in his shop various experimental machine tools that he runs at various speeds by the use of this electric-driven double-drive lathe. He uses the lathe as a variable-speed device by putting the shaft on centers which carry the drive pulley. In this way he obtains several variations of speed and motor drive, direct or reverse.

FUSE FOR INSTRUMENT TRANSFORMERS.

The fuse shown herewith has been developed to open the circuit of shunt instrument transformers successfully under excessive current conditions with the minimum of disturbance or noise. The fuse may be located in any convenient position, near the switchboard or elsewhere, no cells or barriers being necessary. The fuse resembles the ordinary type of inclosed fuse, the fuse proper being a small wire which passes through the center of the fiber tube 1.5 in. in diameter. The wire is soldered at each end to the center



Fuse for Instrument Transformers.

of a metal cap, which is placed over the end of the tube. Surrounding the fuse wire is a filler which absorbs such a percentage of the arc that the blowing of the fuse causes no external disturbance. The metal caps are provided with vent holes, so arranged that the filler will not leak out. The fuse can be used at emfs up to 15,000 volts. It has been developed for the market by the General Electric Company.

THREE-WIRE DIRECT-CURRENT GENERATORS.

Three-wire systems for the distribution of electrical energy at low voltages, direct current, were developed during the pioneer period of the art of electric lighting. They have been and are now used extensively for energy distribution for lighting and motor service over short distances, principally because of the copper economies that they effect. The advantages of a self-contained three-wire machine for operating three-wire systems as well as the commercial and engineering advantages of a three-wire balanced voltage system many years ago led to the development of three-wire balanced voltage generators. The method is of interest at this time because of its application to modern commutating-pole dynamos.

The single-voltage three-wire system retains all of the essential advantageous characteristics of the ordinary three-wire system; in addition, it has the important advantage that only one machine is required. It utilizes a very simple arrangement for obtaining inherently balanced three-wire systems. The principal difference between three-wire generators and standard single-voltage, direct-current

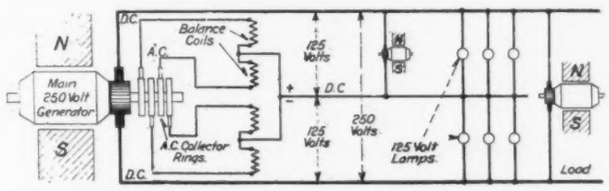


Fig. 1—Diagram of Connections of Three-Wire, Direct-Current Generator.

machines is that with the three-wire dynamo auto-transformers or so-called "balance" coils are added and certain connections to the balance-coil windings are provided, as shown in the diagram (Fig. 1).

The devices that convert the machine from a two-wire to a three-wire generator are so small that a three-wire generator is almost as compact as a two-wire machine of equivalent output. Collector rings are mounted at one end of the armature and the connecting leads to them are similar to those employed on the alternating-current side of a rotary converter armature. The superiority of a three-wire generator, which is merely a standard two-wire machine with certain simple parts added to its armature, over a complicated arrangement involving special armature windings is apparent.

The balance coil auto-transformer is connected across each pair of two-phase collecting rings. This coil consists of a single winding on a laminated iron core and is similar in mechanical construction to a distributing transformer. The assembled coils are contained in a cast-iron case similar to those employed for transformers. The middle points of the balancing coils are interconnected, and from this connection the neutral lead of the three-wire system is brought out.

The performance of the three-wire generator is practically identical with that of a two-wire generator. The losses in the balance coils are so small as to be negligible. The inherent voltage regulation of the machines is said to

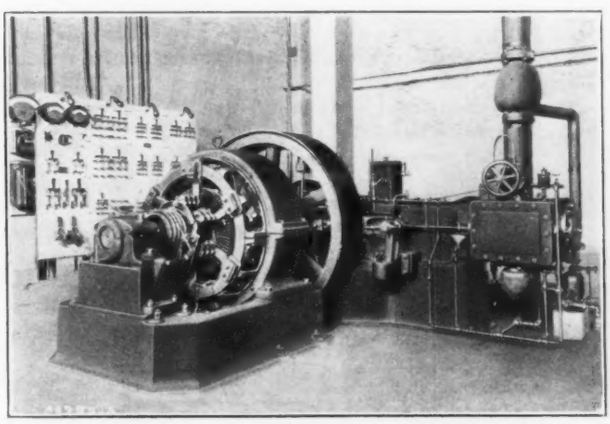


Fig. 2—Three-Wire, Direct-Current Generator Installation.

be excellent. Three-wire generators are usually wound for 125-250. They may be compounded to impress an increasing voltage with an increasing load, as is the usual practice with single-voltage machines. It is customary to divide the series field turns into two parts, connecting one part in the positive and the other in the negative line lead in order that the regulation may be preserved at all loads. Commutating poles assure sparkless commutation from no load to heavy overloads.

The three-wire direct-current system finds its application in the distribution of energy for lighting and motor service in office buildings, machine shops, stores, manufacturing establishments, and in all installations where the receiving apparatus is located within a mile or so of the generator. A typical application is shown in Fig. 2, which illustrates one of two similar three-wire generators installed in the Grand Rapids (Mich.) high schools. The balance coil is visible in the illustration just to the left and back of the switchboard.

Three-wire generators may be operated in parallel as satisfactorily as two-wire machines. The balance coils are connected directly to the collector rings, and the neutral wire is carried to the switchboard. It is unnecessary to synchronize or connect the alternating-current sides of the armatures in parallel, and it is not necessary to consider the frequency of the alternating currents generated in the armatures of the different machines. Three-wire generators can be operated in parallel irrespective of the number of poles and speed of each just as easily and simply as two-wire generators can be regulated for equal voltage. Two-wire and three-wire generators can be operated in parallel with each other, and the latter will handle any unbalanced load.

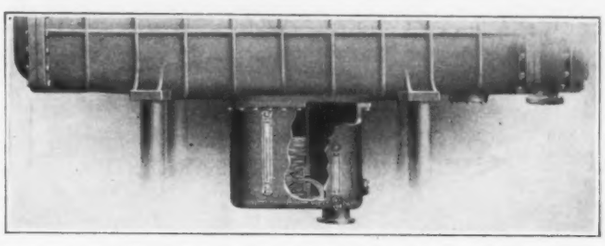
The above-described three-wire generator has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

INDICATING HOT-WELL FOR MEASURING STEAM CONSUMPTION.

The steam consumed by a turbine or engine can be determined with absolute accuracy by weighing the condensate from a surface condenser. Very few plants have employed this method of measurement, owing to the fact that ordinary weighing or measuring devices are costly and clumsy and not only add to the expense but complicate piping and are none too accurate. A simple, direct solution of the problem is presented in the indicating hot-well illustrated herewith, which is similar in size and appearance to the ordinary hot-well.

The hot-well is attached directly beneath the condenser, the opening in the bottom of the condenser being built so that the condensate drains into the left-hand chamber of the hot-well, and communication from this chamber to the hot-well pump suction is secured through an orifice in the dividing wall.

The velocity of discharge through an orifice of given diameter varies directly as the square root of the head, and the quantity of water discharged is equal to the product



Method of Measuring Steam Consumption.

of this velocity, the area of the orifice and the coefficient of contraction. With a properly designed orifice this coefficient remains almost exactly constant for widely different values of the head upon the orifice, and therefore the quantity of discharge is obtained with a high degree of accuracy by a carefully calibrated indicating gage glass, reading the head.

As may be seen from the illustrations, the orifice is formed in a brass plate inserted in the partition wall. It is polished and finished to insure accuracy of flow. Especially manufactured fittings are used to attach the indicating gage to the shell of the hot-well. Ball check valves are provided in each fitting so that should the gage glass break the inflow of air will be prevented and the gage glass can be replaced at leisure. A gage glass is also provided to show the height of the water in the hot-well suction compartment, where the water must not be allowed to submerge the orifice. The scale attached to the indicating gage reads directly in pounds of steam per hour, as shown in the drawing. Each orifice is made independently, carefully calibrated, and a special scale, etched upon steel, furnished for it. Over the whole range of readings the accuracy is within 2 per cent, and for readings from 75 per cent to 125 per cent load the accuracy is within 1 per cent.

The indicating hot-well gage reads in pounds of steam per hour; the station wattmeter gives the load in kilowatts, and the rate of steam consumption in pounds per kilowatt-hour is obtained by simple division. This figure entered regularly upon the engineer's log sheet, and charted from day to day, is of great importance in maintaining high plant economy.

The above-described device has been placed on the market by the Wheeler Condenser & Engineering Company, Carteret, N. J.

BATTERY SWITCHES IN GANG TANDEM.

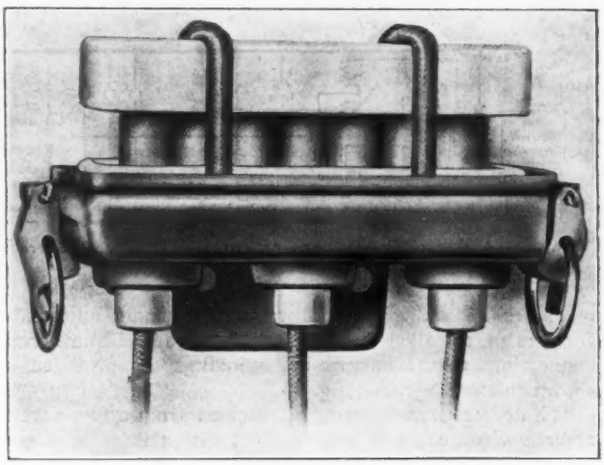
The battery switch made by the Cutler-Hammer Manufacturing Company, Milwaukee, has been furnished standard as a single switch or in gangs, side by side, with suitable gang flush plates. Recently an increasing demand for switches in gang one above the other, or in tandem, has caused the adoption of a standard tandem construction and tandem plates in addition to the ordinary gang arrangement. The accompanying illustration shows a three-

Three-Gang Tandem Switch.

gang tandem arrangement. The frames of the individual switches are riveted to a connecting steel link and the solid flush plate is fastened to the switches after they are installed by means of machine screws. The switches are rated at 10 amp, 80 volts, and are operated by a push and pull button. Pushing the button opens the circuit (instead of closing it), preventing frequent wasteful burning of the lamps due to accidental pushing of the button during the daytime.

SPARK-GAP LIGHTNING ARRESTER.

The lightning arrester shown herewith consists of seven cylinders of non-arcing metal mounted between overhanging porcelain supports and inclosed in a weatherproof iron box. Leads are brought out from the first, last and middle cylinders. For emfs up to 1250 volts one arrester can be used as a protection for both sides of a two-wire circuit, the middle lead being grounded. On higher voltage one outside lead is grounded and the arrester is used as a single-pole unit. The static charge spreads over the surface of the cylinders and jumps across the gaps between them. Because of the large size of the cylinders the arrester has an instantaneous current capacity that materially aids in clearing the line disturbances, while its equivalent spark gap is said to be extremely low. This type of arrester is intended for use on circuits having an equipment rating not exceeding 200 kw if installed within a radius of 2 miles



Spark-Gap Lightning Arrester.

from the source of energy. An additional rating of 100 kw is permissible for each additional mile. These limits are specified by the manufacturers to allow for the ability of the arrester to suppress any generator arc following a discharge. This arrester has been developed by the Westinghouse Electric & Manufacturing Company for use on alternating-current circuits operating at from 500 volts to 2500 volts.

WIRE CONNECTOR.

The Morriseff Electric Manufacturing Company, 84 Walker Street, New York, is placing on the market a wire connector, called "Nosplice," for connecting up fixtures to

Fig. 1—Wire Connector for Connecting Fixtures to Outlets.

outlets, by which the disadvantages of soldering and tapping joints are obviated. Tenants frequently call on the owners of buildings either to change the location of fixtures or substitute others, and if a fixture should happen to be connected with solder and tape, it means that before it is removed the outlet wires must be cut and thus shortened; if, however, connected by means of this device, the fixture can be taken off by simply loosening one screw. With the old method of making a fixture connection, a flaming torch must be carried around, often over inflammable material, and if the torch is accidentally upset, or the match that lights it carelessly thrown away, a fire is apt to result.

Fig. 2—Cross-Section of Wire Connector.

Other advantages are the saving in time in connecting up and less liability of soiling ceilings and walls. The accompanying engravings illustrate the device. When the screws are tightened the heads are concealed by a cover attached to a band.

Industrial and Commercial News

HIGHER prices for steel for shipment in the second and third quarters of the year are expected to result from the present degree of activity in that industry. The mills of the Steel Corporation, and those of the independents as well, are operating at a rate closely approaching full capacity, so that further increase in demand will be sufficient justification for increase in prices. Advices on the business situation indicate a tone of hopefulness throughout the country, tinged with an inclination toward conservatism. Signs of advancement may be found in the rate at which the promotion of new enterprises is going forward and in the broader scale upon which buying is being done. Call money was quoted at 2½@3 per cent in New York on April 17, and 3½@3¾ per cent was asked for accommodation for ninety days.

THE COPPER MARKET.

The average price of electrolytic copper this week was about 15⅞ cents, thirty days, and many of the leading producers expressed a belief that even higher prices may be expected before long. From the narrow scale of buying at current prices, however, it seems extremely doubtful if further advance could be made successfully at this time. Export business is fairly good, and mild expansion is expected to result from resumption of normal working conditions in Great Britain, but domestic consumers are very reluctant to purchase and contributed very scantily to the volume of sales this week. The absence of selling pressure which characterizes the market seems to indicate a realization by part of the producing element that present prices are about as high as practicable under conditions existing in general trade. With only slow recovery in progress in most of the leading industries, there is little possibility of early expansion in the copper trade, and especially if the price of the metal is placed beyond the reach of consumers. During the month, including April 17, exports have totaled 12,786 tons. The daily call on the New York Metal Exchange April 17 quoted copper as per the accompanying table.

Standard.	Bid.	Asked.	Settling Price.
Spot	15:50	15.87½	.....
April	15.50	15.87½	15.70
May	15.55	15.87½	15.70
June	15.55	15.87½	15.72½
July	15.55	15.87½	15.72½

The London market April 17 was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	70 10 0	70 6 3
Standard copper, futures	71 7 6	71 3 9

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	15.62½c	13.65c
London, spot	£71 0 0	£60 16 3
London, futures	72 2 6	61 10 0
Best selected	75 5 0	65 5 0

INDUSTRIAL AND COMMERCIAL NOTES.

Present Status of Winnipeg Utilities—At the recent session of the Legislature of the Province of Manitoba bills were passed which authorize the Winnipeg Electric Railway to dispose of its holdings, plant and franchise and empower the Manitoba Power Company to purchase the rights of any electric railway, light or power company in the province which is disposed to sell. These bills insure the success of negotiations which have been progressing for a year for the purchase of the property of the Winnipeg Electric Railway by the Manitoba Power Company. In addition to this purchase the deal will include the consolidation of a number of other companies which have the right to conduct electric railway, power, light and gas business in the province. Among these companies are the Brandon Street Railway, the Rural Railways of Manitoba, the Winnipeg River Railway and the Winnipeg Northeastern Railway. In 1910 the R. R. Muir Syndicate secured letters patent from the Dominion government to do business as a light, heat, power and railway company in Canada. These were ratified by the Manitoba Legislature the following spring, and very wide powers were granted. In 1911 the syndicate secured control of Big Bonnet Falls on the Winnipeg River, about 70 miles from Winnipeg, capable of developing 150,000 hp. It also secured franchises for the companies previously mentioned and opened negotiations with Sir William MacKenzie, president of the Winnipeg Electric Railway, for the purchase of that property. While these negotiations were in progress the city of Winnipeg and the Winnipeg Electric Railway were at odds over the rights of the company to do business in the city. The issue was taken to the Privy Council at London, and the case was decided against the city as noted in the *Electrical World*, March 2, 1912, page 447.

Two New English Diesel Engine Companies.—According to London dispatches which have been confirmed by good authority in this country, two new companies, the Consolidated Diesel Engine Manufacturers, Ltd., and the Burmeister & Wain (Diesel System) Oil Engine Company, Ltd., have been organized in London to engage in the manufacture of Diesel engines. The first-named company, which is formed to effect an amalgamation between the Diesel Engine Company, Ltd., of London, and Messrs. Carels Frères (Société Anonyme), Ghent, and to erect new works in England for the manufacture of the Diesel engine, is capitalized at £750,000 in shares of £1 each. Of the present issue of 600,000 shares, 72,924 shares are reserved for exchange against the capital stock of the Diesel Engine Company, Ltd., of London, and 100,000 shares are to be allotted as part payment for one-half the capital stock of Messrs. Carels Frères, while the balance, 427,076 shares, will be offered for subscription at par. The second of the new companies, the Burmeister & Wain (Diesel System) Oil Engine Company, Ltd., is capitalized at £550,000, of which £530,000 is in 6 per cent participating preferred shares of £1 each, and £20,000 in deferred shares of 1 shilling each. A license granted to Barclay, Curle & Company, Ltd., of Glasgow, is to be transferred to this company. Dr. Rudolf Diesel, who is now in this country, as noted in the *Electrical World*, April 13, page 823, is a director in the new Consolidated Diesel Engine Manufacturers, Ltd., as well as in the Busch-Sulzer Brothers-Diesel Engine Company, in this country.

Holophane and Fostoria Glass Companies Consolidated.—It was stated in these columns on April 6 that the General Electric Company had recently completed negotiations for taking over the entire organization of the Holophane Company and that the Fostoria Glass Specialty Company would be united with the Holophane organization, probably in the form of a new company. We are now able to state that on April 29 the Nelite Works of the General Electric Company will become the successor of the Holophane and Fostoria companies, with headquarters at the Vickers Building, Sixty-sixth Street and Euclid Avenue, Cleveland, Ohio. Manufacturing will be continued as heretofore at the plants of the Holophane and Fostoria companies at Newark, Ohio, and Fostoria, Ohio, respectively, and will be under direction of E. O. Cross. The sales and engineering parts of the business will be directly under the charge of V. R. Lansingh, as noted April 6.

A New Illinois Utilities Company.—The Illinois Northern Utilities Company was incorporated under the laws of Illinois on April 11, with a nominal capital of $1,000. Consolidation of various public utility enterprises centering about Sterling and Rock Falls, Ill., will result, it is thought, from organization of this company. It is probable that the new company will have friendly relations with the United Light & Railways Company, of Grand Rapids, Mich., which recently secured control of the Tri-City Railway & Light Company of Davenport, Ia., operating in Rock Island and Moline, Ill., and Davenport, Ia., as noted in these columns March 16 and 23, 1911. Large increase in the initial capital of the Illinois Northern Utilities Company is expected soon.

Pacific Gas & Electric Annual Meeting.—At the annual meeting of the Pacific Gas & Electric Company at San Francisco April 9 the following were elected directors to serve during the ensuing year: Frank B. Anderson, Henry E. Bothin, John A. Britton, W. H. Crocker, E. J. de Sabla, Jr., F. G. Drum, John S. Drum, D. H. Foote, A. F. Hockenbeamer, C. O. G. Miller, William G. Henshaw, John Martin, Samuel Insull, Louis Sloss, George K. Weeks. The following officers were re-elected: President, F. G. Drum; first vice-president and general manager, John A. Britton; second vice-president and treasurer, A. F. Hockenbeamer; secretary and assistant treasurer, D. H. Foote; assistant treasurer, Joseph C. Love; assistant secretaries, Charles L. Barrett, Morris K. Parker. The new directors are C. O. G. Miller, William G. Henshaw and Samuel Insull. The election of the latter to the board was in line with the recent purchase by Mr. Insull and an Eastern syndicate of 40,000 shares of Pacific Gas & Electric stock from the estate of the late W. W. Halsey, as mentioned in these columns March 23, 1912.

Annual Meeting of the Joseph Dixon Crucible Company.—At the annual meeting of the stockholders of the Joseph Dixon Crucible Company, held at the company's main office in Jersey City, N. J., on April 15, the retiring board of directors, consisting of George T. Smith, William Murray, Edward L. Young, William H. Corbin, George E. Long, William G. Bumsted and Harry Dailey, was unanimously re-elected. Officers elected for the ensuing year are as follows: President, George T. Smith; vice-president, W. H. Corbin; treasurer, George E. Long; secretary, Harry Dailey; assistant treasurer and assistant secretary, J. H. Schermerhorn. There were voted 9304 shares of a total of 10,000. A number of stockholders attended the meeting and expressed themselves as well pleased with the company's showing and with future prospects.

High-Head Water-Power Project in Alabama.—Plans are being carried forward rapidly for the formation of the Little River Power Company, which will supply energy throughout the northern part of Alabama. The construction of three water-power developments, having a total rated output of 150,000 hp, is contemplated. The first of these will be on the Little River, near Fort Payne, Ala., and will have a rating of 50,000 hp under a head of 590 ft. Energy will be transmitted from this plant at 100,000 volts to Anniston, Gadsden, Huntsville and neighboring localities. The matter at present is in the engineer stage, and contracts for equipment and construction work have not been let. The company, when formed, will be affiliated with the Electric Bond & Share Company, 71 Broadway, New York.

Amundsen's Ship and Its Engine.—In our issue of March 16 a note appeared relating to Amundsen's ship the *Fram*, in which it was stated that the vessel was equipped with an engine built by the Norwegian Diesel licensees. We are informed by the Aktiebolaget Diesels Motorer of Stockholm that the engine was built at its works in Sweden and that this company is not licensee but builds engines under its own patents. The Swedish company has equipped twenty-two vessels with Diesel propelling machinery, among which is the *Toiler*, the first vessel propelled by a gas engine to cross the Atlantic.

New Haven Road to Extend Electrification.—Work is to start immediately upon electrification of the main line of the New York, New Haven & Hartford Railroad between Stamford and New Haven, Conn. The work is to be completed before the end of this year and is to cost about $4,000,000.

Aluminum Notes and Prices.—Prices for aluminum per pound in ton lots as of April 17 were: No. 1 pure ingot, 19@22 cents; rods and wire, base price, 31 cents, and sheets, 33 cents.

Financial

May Sell Cleveland (Ohio) Electric Illuminating Company.—Harrison Williams, 60 Broadway, New York, has made a proposition to the Cleveland Electric Illuminating Company, of Cleveland, Ohio, to purchase at least 80 per cent of its common stock at $130 per share, and it is said that owners of a majority of this stock have already signified their intention to sell, including Myron T. Herrick, Ambassador to France, the largest stockholder in the company. James Parmelee, president of the company, has sent the following letter to holders of the common stock: "Several large stockholders in the Cleveland Electric Illuminating Company have expressed a desire to sell their holdings of the common stock of that company. Acting upon their suggestion, in connection with ex-Governor Herrick and certain other large shareholders, I have succeeded in obtaining an offer from Mr. Harrison Williams to purchase at $130 per share and accrued dividends not less than 80 per cent of the common stock of the company. Owners of a majority of this stock have accepted the offer upon the express understanding that the same offer shall be made to all common shareholders alike. Mr. Williams' offer has been under advisement by the majority shareholders for a considerable time, and they are satisfied that the terms proposed are the best obtainable, that Mr. Williams is in a position financially to make the contemplated purchase, and that a sale of the stock upon the terms of the inclosed agreement is advantageous to the shareholders." The Cleveland Electric Illuminating Company has at this time $5,000,000 of 5 per cent bonds outstanding, which cannot be retired until 1924, and the transfer of the property cannot disturb the security behind them. In addition, the company has outstanding $800,000 of 6 per cent cumulative preferred stock and $7,399,000 common stock. The common stock pays dividends at the rate of 8 per cent and holders have several times had the privilege of participating in the purchase of new stock at par when it was worth much more on the open market. The highest price paid for this stock on the Cleveland Stock Exchange in 1911 was 134 in January and the lowest price was 121 in December. Recent sales have been made at 127.

Cleveland Municipal Plant.—No official bids were received for the first $1,000,000 of municipal light bonds by City Auditor Coughlin on April 8, the day on which proposals were to be opened, as noted in these columns March 2, page 449. An informal proposition was received from Otis & Hough and Hayden, Miller & Company to pay a premium of $750 on the bonds, provided they are legal. The attorney for the latter firm stated that he would want the matter to stand until July 1 in order to ascertain the legal standing of the securities. W. B. Drum, connected with the office of Otis & Hough, acting as a taxpayer, had previously filed suit asking that the city be enjoined from selling the bonds. He alleges that the Council was without power to adopt a resolution on Sept. 18, 1911, to submit the question of issuing bonds for the dual purpose of erecting a light plant and supplying light. He says further that the election was void because sixty days had not intervened between the dates of passing the resolution and holding the election. He also alleges that the ordinance passed on Feb. 19, 1911, is void because the original resolution provided for the sale of the bonds during the fiscal year beginning Jan. 1, 1911, only. The ordinance authorizing the sale of bonds did not become operative until sixty days after its passage, he says, which date was April 18, 1912.

McCrum-Howell Reorganization.—A. H. Wiggin, president of the Chase National Bank, New York; Herman Waldeck, vice-president of the Continental Commercial National Bank, of Chicago, and John C. McKeon, vice-president of the National Park Bank, New York, who are the committee formed to represent the banks in the reorganization of the McCrum-Howell Company, vacuum-cleaner and enameled-ware manufacturer, as noted in these columns April 13, have been appointed a committee to prepare a plan for rehabilitation of the company. This committee will have power to reorganize the company or its subsidiaries, or to adjust claims against the company without a reorganization.

Great Western Power Meeting.—The annual meeting of the stockholders of the Great Western Power Company was held in San Francisco on April 2, 1912. All of the stock was represented and the following officers were elected for the year: Mortimer Fleishhacker, president; Herbert Fleishhacker, vice-president; H. P. Wilson, vice-president and secretary; Guy C. Earl, vice-president; H. H. Sinclair, vice-president; F. M. Tompkins, treasurer and assistant secretary; W. H. Spaulding, assistant treasurer and auditor. The company was found to be in a prosperous condition.

Chicago Telephone Financing.—New York banking interests have purchased $14,000,000 first-mortgage 5 per cent gold bonds of the Chicago Telephone Company and are offering them at 102¼ and interest, yielding about 4.75 per cent. These bonds are dated Dec. 1, 1908, and are due Dec. 1, 1923. Benjamin E. Sunny, president of the company, in a letter to the purchasers, says that the Chicago Telephone Company was incorporated Jan. 14, 1881, and owns and operates the Bell telephone system in the territories comprising the counties of Cook, Dupage, Kane, Lake, McHenry, Grundy, Kendall and Will, Ill., and the counties of Porter and Lake, Ind., having a population of about 2,850,000. The company operates in conjunction with the long-distance lines of the American Telephone & Telegraph Company, which has always owned more than a majority of the stock of the Chicago Telephone Company. It recently increased its ownership by exchanging its own stock for that of the Chicago Telephone Company. The authorized capitalization of the latter consists of $30,000,000 capital stock, of which $27,000,000 is outstanding, and $50,000,000 first-mortgage bonds, of which $19,000,000 are outstanding, including the present issue. Continuous dividends of not less than 8 per cent have been paid on the capital stock for the past twenty-eight years. Gross revenue of the company in 1911 was $12,678,390, and net earnings were $2,523,895, or more than two and one-half the $950,000 interest charges on the $19,000,000 5 per cent bonds outstanding.

Beloit (Wis.) Water, Gas & Electric Bonds.—New York banking interests are offering first-mortgage, twenty-five-year 5 per cent sinking-fund gold bonds of the Beloit Water, Gas & Electric Company, which does all the electric light, gas and power business, including municipal lighting, of Beloit, Wis., and South Beloit, Ill., and also furnishes the exclusive supply of water to these towns for domestic and municipal purposes. The authorized capitalization of the company consists, first, of $3,000,000 first-mortgage, twenty-five-year 5 per cent sinking-fund gold bonds, of which $900,000 are outstanding, additional bonds being issuable under this mortgage only for permanent improvements or extensions, at a rate that shall not exceed 80 per cent of the actual cash cost and then only when the net earnings for the twelve preceding months shall have been equal to at least twice the annual interest charges on all outstanding bonds and on the bonds to be issued. In addition to its bonds the company has $500,000 7 per cent cumulative preferred stock and $500,000 common stock, all of which is outstanding. Gross and net earnings have shown continuous increase in the past five years, and the net income for the calendar year 1911 was $95,699, which is more than twice the annual interest charges on the bonds now outstanding.

Annual Report of United Railway & Electric Company of Baltimore.—Stockholders of the United Railways & Electric Company, of Baltimore, at their annual meeting last week, re-elected the retiring board of directors. The thirteenth annual report of the company, covering operations for the fiscal year ended Dec. 31, 1911, was presented and showed that the record of that year was the best in the history of the company. Gross earnings reached $8,000,000 for the first time, being $8,025,758, an increase of 4.39 per cent over the 1910 returns. The operating expenses were $3,681,093, an increase of 2.20 per cent, and the fixed charges were $2,859,685, an increase of 2.07 per cent. After deducting all fixed charges, taxes, rentals, etc., and $60,000 sinking fund for the Maryland Electric Railway Company 5 per cent bonds there was left a net income of $1,427,618. From this were deducted extraordinary expenditures amounting to $450,944 (for betterments), interest on income bonds and dividends on preferred stock, totaling $560,000, leaving a balance carried to profit and loss of $416,674. The general balance sheet as of Dec. 31, 1911, showed total assets and liabilities of $175,549,126.

To Generate Energy for New England Cotton Mills.—Formation of a company to be known as the Southern Massachusetts Power Company, with a capital of $1,000,000, is being promoted jointly by the Fall River Electric Light Company, of Fall River, Mass., and the New Bedford Gas & Edison Light Company, of New Bedford, Mass. The object in view is to have this company furnish under contract the energy needed by the promoters. A campaign for supplying central-station service to the numerous cotton mills in the territory will be carried on. The majority of the mills in the section are now operating private plants, the most noteworthy exception being the Pilgrim Mills at Fall River, a 60,000-spindle mill of the most modern type, which is supplied with energy by the Fall River Electric Light Company, as described in these columns April 20, 1911. Directors of the Fall River company have agreed to sell the company's generating station and adjacent land to the Southern Massachusetts company, and the stockholders, at a special meeting April 25, will vote to ratify this action.

New Orleans Railway & Light Earnings in 1911.—The pamphlet report of the New Orleans Railway & Light Company for the year ended Dec. 31, 1911, shows substantial improvement in all departments of the company's business. Total operating revenue was $6,652,937 as compared with $6,245,223 in 1910. The returns for the railway department were $4,465,194, the returns for the electric department were $1,182,497, and those for the gas department were $1,005,245, comparing with $4,206,303, $1,072,546 and $966,373, respectively, in the previous year. Total operating expenses were $3,737,124, as against $3,251,738 in 1910, when a special charge of $150,000 for depreciation was included under this head. The surplus after all charges was $771,696, which is equal to 7.71 per cent on $10,000,000 preferred stock and compares with $643,289, or 6.43 per cent, in 1910.

Philadelphia Electric Earnings Improve.—The report of the Philadelphia Electric Company for the year ended Dec. 31, 1911, shows gross earnings of $6,425,590, comparing with $5,946,026 in 1910, and net income of $1,403,341, comparing with $1,216,378. Final results of the year's operations showed an increase of $22,487 paid in cash dividends and $504,007 added to the surplus, making a total surplus of $1,127,393. The number of customers was increased by 4943 during the year, and the total connected load in 50-watt equivalents was increased by 252,488, the total as of Dec. 31, 1911, being 2,430,955. This does not include new contracts for supplying energy to the Philadelphia Electric Company, noted in these columns March 16. Retiring directors were elected at the annual meeting.

Deming Ice & Electric Company Sold.—The Federal Light & Traction Company, 60 Broadway, New York, has acquired all the outstanding securities of the Deming Ice & Electric Company, which controls the local electric light, power, ice and coal business of Deming, N. M., serving a population of 3000. In addition to the foregoing, the company supplies energy to the adjacent territory for irrigation purposes. An 850-hp unit is being added to the station of the company to enable the taking on of new pumping and irrigation business, resulting from recent discovery of three underground strata of water, sufficient to irrigate a large acreage.

Annual Meeting of Marconi Wireless.—John R. Sheffield, John L. Griggs and Kenneth K. MacLaren were elected directors of the Marconi Wireless Telegraph Company of America at the annual meeting on April 15. One of the newly elected directors takes the place of Charles A. Terry, resigned, and the other two fill vacancies of several years' standing. Holders of Marconi stock of record April 18 will be allowed to subscribe at par to five times their present holdings within ten days after that date.

Boston Edison to Buy Lighting Companies.—At a special meeting to be held April 24 stockholders of the Edison Electric Illuminating Company, of Boston, will be asked to authorize the purchase of the franchise and properties of the Weston Electric Light Company and the Hyde Park Electric Light Company and to authorize additional stock issues for extensions to these properties. Control of these companies passed to President Edgar, of the Boston company, some time ago, as noted in these columns Jan. 20, 1912.

Pennsylvania Power Company Increases Capital.—Notice of an increase in capital stock from $5,000 to $400,000 has been filed by the Pennsylvania Power Company, Pittsburgh.

MARKET PRICES.

	April 10.	April 17.		April 10.	April 17.
Allis-Chalmers	2	1⅝	Mackay Companies..	84¾	85¼
Allis-Chalmers, pf...	5⅛	3¼	Mackay Cos., pf....	69⅜*	69¼
Amalgamated Cop...	81⅜	83½	Philadelphia Elec...	18	18½
Boston Edison 291		285*	Western Union.....	83	82¼
C'monwealth Edison.146½		145½	Westinghouse	76½	75¼
Elec. Storage Bty...	55¼	55	Westinghouse, pf....122½*		122½*
General Electric.....171		170¼			

*Last price quoted.

Personal

Mr. W. A. Bixby, manager of the Springfield (Mo.) Gas & Electric Company, has been critically ill with an affection of the liver.

Miss Alice B. Simoneau has been appointed treasurer of the Saginaw (Mich.) Power Company, succeeding Mr. J. W. Glendenning.

Mr. T. W. MacClelland, of the sales department of the Union Electric Light & Power Company, St. Louis, has been appointed illuminating engineer.

Mr. W. H. Tolman, director of the American Museum of Safety, gave an illustrated lecture on "Civic Beauty" before the Colorado Electric Club, Denver, April 11.

Mr. E. C. Burnett has been appointed assistant electrical engineer of the Union Electric Light & Power Company, St. Louis, succeeding Mr. K. H. Hansen, who was recently promoted to be chief engineer.

Mr. H. H. Magdsick, at a meeting of the Pittsburgh Section of the Illuminating Engineering Society on Friday evening, April 12, spoke on the subject "Gas, Gasoline, Arc and Incandescent Street Lighting."

Mr. H. M. Hirschberg, who was largely instrumental in the introduction of flaming-arc lamps in this country, left New York on the Olympic April 13 for his annual visit to the manufacturing centers of Europe.

Mr. Charles H. Peddrick, Jr., manager of the light and power department of the Hudson River Electric Power Company at Glens Falls, N. Y., has been made general manager of the Spring Brook Water Company, Hudson Falls, N. Y.

Mr. Arthur S. Watts, author of the article entitled "Detailed Comparison of High-Tension Insulation of American and European Design," which appeared in our issue dated May 19, 1910, has been elected president of the American Ceramic Society.

Mr. Charles W. Rogers was on April 1 appointed superintendent of generation for the Empire District Electric Company's system with headquarters at Joplin, Mo. Mr. Rogers was formerly combustion engineer for the Detroit United Railways Company.

Mr. Charles J. Russell is the author of an article in the March issue of *Current News*, published by the Philadelphia Electric Company N. E. L. A. Section, entitled "Corporation," which gives a historical account of the origin and development of the corporate idea.

Mr. E. G. Connette has resigned as chief of the transportation department of the New York Public Service Commission, which position he has held since Sept. 1, 1909, to undertake certain railway work, the plans for which have as yet not been announced. His resignation will take effect on May 15.

Mr. John Hunter, chief engineer of power plants of the Union Electric Light & Power Company, St. Louis, addressed the University of Missouri Branch, A. S. M. E., at Columbia, Mo., April 5, on the subject "The Development of Modern Power Stations," illustrating his remarks with lantern slides.

Mr. J. W. Reeve has resigned as manager of the Madison Electric Light & Power Company, of Madison, Fla., to accept the position of superintendent of the Ware County Light & Power Company of Waycross, Ga. An error appeared in the previous announcement in this column of Mr. Reeve's change of position.

Mr. D. E. Thompson, Toronto, has been elected president of the Mexican Northern Power Company, Santa Rosalia, Mexico, to succeed Mr. G. F. Greenwood, who has been made vice-president and general manager of the company, which is constructing a 45,000-hp hydroelectric plant on the Conchos River, 20 miles from Santa Rosalia.

Mr. Fred A. Otto has been appointed superintendent of the electrical department of the St. Paul Gas Light Company, of St. Paul, Minn., succeeding Mr. F. R. Cutcheon, who has become manager for the Consolidated Gas Company of New Jersey at Long Branch. Mr. Otto is a graduate of the Universiy of Minnesota and was until recently engineer of the St. Paul company's turbine generating station.

Dr. Rudolf Diesel, inventor of the Diesel engine, will be made an honorary member of the American Society of Mechanical Engineers on April 30, on the evening of which day Dr. Diesel will deliver an illustrated lecture in the auditorium of the Engineering Societies Building, New York, on "The Development of the Diesel Engine." On April 13 Dr. Diesel addressed the Engineers' Club of St. Louis on the subject of internal-combustion oil engines.

Mr. A. T. Macdonald, general sales manager of the Louisville Lighting Company, will leave on April 30 to attend the annual convention of the Mystic Shriners, which will be held in Los Angeles, Cal. Following this he will visit San Francisco and other coast cities and will attend the Seattle National Electric Light Association convention. He expects to study the Pacific Coast situation from a central-station standpoint thoroughly and to secure all the data possible bearing upon sales methods in use in that section.

Mr. W. L. Arnold, vice-president of the Arnold Company, has returned to his home in Chicago from a trip around the world. Accompanied by his wife, Mr. Arnold left Chicago on Aug. 1 last for a tour of Europe and the Orient from New York, returning by way of San Francisco and reaching Chicago on April 12. From the south of France the travelers embarked on the ship which finally landed them in California, where they were met by Mr. Arnold's brother, Mr. B. J. Arnold. Both Mr. and Mrs. W. L. Arnold express themselves delighted with their globe-circling journey.

Mr. Norman Macbeth has resigned as illuminating engineer for the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and the Westinghouse Lamp Company, Bloomfield, N. J., where he recently organized an illuminating engineering department, and will resume his individual consulting illuminating engineering practice. Mr. Macbeth, who has for some years been closely identified with the practical application of illuminating engineering, will give special attention to illumination development and publicity for central stations and gas companies with particular reference to the education of salesmen, sales campaigns and the handling of competition policies. He will maintain offices in Philadelphia and in New York City.

Mr. Gano Dunn, president of the A. I. E. E., was the guest of honor at a dinner given by the St. Louis Section on Monday, April 8, at the Planters' Hotel, at which more than fifty members and guests were seated. Mr. Dunn spoke quite informally to the members of the section regarding the recently appointed committee on patent matters and explained the reasons which led to its appointment. This was the outcome of a set of resolutions adopted some time ago by the St. Louis Section relating to certain abuses of the patent-law system. Mr. Dunn also spoke about the methods of nominating and electing officers in the Institute and the proposed new amendments to the constitution. Various phases of these subjects were also briefly discussed by Messrs. Langsdorf, Timmerman and Bruninga.

Obituary

Mr. Gilbert B. Shaw, president of the Naugle Pole & Tie Company, of Chicago, died at his residence in that city on April 13. He was seventy-five years of age and had lived in Chicago for forty-four years. Four children survive him.

Mr. Thomas Jefferson Coolidge, Jr., who was largely interested in electric service properties, died at his home in Boston on April 14. Mr. Coolidge was a graduate of Harvard College, Harvard Graduate School and Harvard Law School. In 1890, when only twenty-seven years old, he organized the Old Colony Trust Company. Although banking was the chief business of Mr. Coolidge, he had many other financial interests, especially of late in the field of electric public-service companies. During the past year his increasing illness led him to resign from many directorships, but up to a recent date he was director of the American Bell Telephone Company, American Telegraph & Telephone Company, Western Telephone & Telegraph Company, Edison Electric Illuminating Company, General Electric Company, Georgia Railway & Electric Company, Boston Elevated Railway Company, Underground Electric Railways Company, Ltd., of London, Seaboard Airline Railway, Amoskeag Manufacturing Company, Lawrence Manufacturing Company and American Trust Company.

Construction

HALEYVILLE, ALA.—The installation of an electric-light plant and water-works system, to cost from $8,000 to $10,000, is under consideration. M. S. Drewery is city clerk.

MONTGOMERY, ALA.—James Mitchell, of the Alabama Interstate Pwr. Co., Montgomery, which proposes to develop water-powers on the Coosa and Tallapoosa Rivers, states that it is the intention of the company first to build a plant on the Coosa River to furnish electricity in Birmingham and surrounding cities. Ultimately it is proposed to establish a distributing system throughout Alabama. The company also contemplates harnessing Mussel Shoals on the Tennessee River, near Florence, Ala., for the purpose of operating one or more fertilizer factories which are to be erected. Surveys are now being made on the Coosa River, near Wetumpka, and on the Tallapoosa River, near Alexander City.

BLACK ROCK, ARK.—The Town Council has granted a 25-year franchise to Bond Nichols to install and operate an electric-light plant and has also awarded a contract for street lighting, to cost $50 per month.

LAKE VILLAGE, ARK.—The City Council has granted the Delta El. Lt., Pwr. & Mfg. Co., Greenville, Miss., a franchise to erect and operate an electric plant here. The company was also awarded a contract to furnish power for the city water-works. The cost of the transmission line and system is estimated at about $20,000.

ELSINORE, CAL.—The Southern Sierras Pwr. Co. contemplates taking over the local electric plant, which will be used as an auxiliary plant.

OAKLAND, CAL.—The Oakland Trac. Co., San Francisco, Oakland & San José Consol. Ry Co., Pacific Terminal Co., East Shore & Suburban Ry. Co., California Ry. Co., Sacramento Short Line Ry. and the San José Short Line Ry. have been consolidated under the name of the San Francisco-Oakland Terminal Railways. The company is capitalized at $28,000,000.

OCEANSIDE, CAL.—A special election will be held to vote on the proposition to provide $25,000 for the erection of a municipal electric-light plant here.

RED BLUFF, CAL.—Estimates of the cost of the municipal electric-light and water-works systems have been submitted to the Board of City Trustees by W. F. Luning, city engineer. The cost of the lighting plant was placed at $146,668, and that of the water-works system at $81,992, making a total of $228,660.

REDWOOD, CAL.—A franchise for a street-railway system has been granted by the City Trustees to Edward F. Fitzpatrick. The first line to be built will extend from the business center of the city to the foothills in the Woodside and Portola districts, work on which will begin at once.

SAN FRANCISCO, CAL.—The Board of Public Works has appropriated $90,000 for the construction of power plant and substation for the Geary Street municipal railway.

SAN FRANCISCO, CAL.—Deeds have been filed in the office of the recorder by which the California-Nevada El. Pwr. Co., the Loon Lake Wtr. & Pwr. Co. and the Truckee River General El. Co., three California corporations, have transferred all their property to the Truckee River General Electric Co., which was recently incorporated in Maine with a capital stock of $3,000,000. Wadleigh B. Drummond, of Portland, Maine, is president.

SAN JACINTO, CAL.—Plans are being prepared by Koebig & Koebig, engineers, Los Angeles, for the proposed power plants to be constructed in the San Jacinto Valley for the Romona Pwr. & Irrig. Co., work on which will begin soon.

SANTA ROSA, CAL.—The Great Western Pwr. Co. has applied to the Board of Supervisors for another franchise to operate in Sonoma County.

TEMPLETON, CAL.—Arrangements are being made by the San Joaquin Lt. & Pwr. Co. for the construction of a substation here. The company is now erecting a transmission line to Templeton.

TERRA BELLA, CAL.—The Tulare County Pwr. Co. contemplates extending its transmission lines into the Terra Bella district.

VALLEJO, CAL.—Two bond elections have been authorized by the City Council, one of which is upon the issue of $100,000 to establish a municipal light and power plant.

CONCRETE, COL.—The United States Portland Cement Co. contemplates the installation of a 150-hp power plant. William Fowden is superintendent.

DENVER, COL.—Improvements are contemplated by the Denver & Intermountain R. R. Co. on its Barnum and Golden lines, work on which will soon begin. The work will include a new power house to furnish power to the Intermountain and Denver & Northwestern for use on the line to the Leyden coal mine. Two new lines are also contemplated, one to Fort Logan and the other south from Golden, 3 miles in length. The cost of the work is estimated at about $1,500,000.

NEW HAVEN, CONN.—It is stated that work will begin immediately on equipping the main line of the New York, New Haven & Hartford R. R., between Stamford and New Haven, for electrical operation, the cost of which is estimated at $4,000,000.

STRATFORD, CONN.—The citizens have voted to change the street-lighting system from gas to electricity.

ATLANTA, GA.—The committee decided to lay all bids submitted by the Georgia Ry. & El. Co. for street lighting on the table until June 11 in order that the company may have time to submit a bid on flaming arcs.

BAXLEY, GA.—Bids will be received by the City Council until May 3 for furnishing machinery and materials for an electric-light and water-works system as follows: 900 ft. and 1100 ft. 8-in. and 6-in. cast-iron pipe and fittings, constructing reservoir, furnishing boiler, feed-water heater, triplex and boiler-feed pump, air compressor, installing machinery complete, including switchboard; furnishing and installing electric line wire, poles, generator, exciter, switchboard, series transformers, transformers and engine, and erecting power house. Plans and specifications may be seen and obtained at the office of William W. Lyon, consulting engineer, 305 Duval Building, Jacksonville, Fla. Wade H. Watson is Mayor.

HELENA, GA.—The City Council has decided to install an electric-light system here. Electricity for operating the system will be secured from the municipal electric plant at McRae. This city is to own and operate the distributing system.

MACON, GA.—The Board of Water Commissioners has decided to use electricity to operate the pumping station of the new water-works system. W. P. Bullock, Kansas City, Mo., is consulting engineer.

McRAE, GA.—The proposition to issue $5,000 in bonds for the installation of a new electric-light system will be submitted to a vote on May 7.

MONTICELLO, GA.—The Central Georgia Pwr. Co. will supply electricity here by Aug. 1. The City Council has contracted for 500 hp and the Monticello Cotton Oil Co. for 150 hp.

VALDOSTA, GA.—The plant and holdings of the Consolidated Ice & Pwr. Co. have been purchased by the Municipal Service Co., Philadelphia, Pa., for $300,000.

BOISE, IDAHO.—The Southern Idaho Lt., Ht. & Pwr. Co. has changed its name to Idaho Ry., Lt. & Pwr. Co. and has increased its authorized capital stock from $20,000,000 to $30,000,000.

POCATELLO, IDAHO.—The Idaho Consol. Pwr. Co. contemplates increasing the output of its plant at American Falls by 4000 hp. J. H. Brady, Boise, is president.

ALTON, ILL.—A proposition for street lighting has been submitted to the special committee of the Council by C. M. Yager, representing a new company, for municipal lighting. If awarded the contract for street lighting, the company will be incorporated under the name of the Piasa Lt. & Pwr. Co. and will have a capital stock of $300,000. The present contract, held by the Alton Gas & El. Co., will expire September, 1913. The new company offers reduced rates to private consumers as well as for municipal service.

BEARDSTOWN, ILL.—The Beardstown El. Lt. & Pwr. Co. is planning to make improvements and extensions to its plant.

BUFFALO, ILL.—The capital stock of the Central Illinois El. Co. has been increased from $2,500 to $10,000.

HARRISBURG, ILL.—The capital stock of the People's Wtr. & Lt. Co. has been increased from $50,000 to $75,000 to provide funds for extensions. F. J. Postel, of Chicago, is president and J. R. Cravath, 1160 Old Colony Building, Chicago, Ill., is general manager.

HILLSBORO, ILL.—Plans for a new street-lighting system will soon be submitted to the City Council by the Hillsboro Lt. & Pwr. Co. It is proposed to substitute tungsten lamps for arc lamps.

MAHOMET, ILL.—The Village Board has granted F. E. Wright a 20-year franchise to construct and operate an electric-light plant here.

MIDDLETOWN, ILL.—A committee of business men, composed of F. H. Mullen, J. A. Glenn, Louis Kief, James Snyder and William Walters, has been appointed to make investigations and secure the cost of the installation of an electric-light plant.

PEKIN, ILL.—The Pekin Lt., Ht. & Pwr. Co. has decided to secure electrical energy from the Peoria plant. It is said that arrangements have been made to erect the transmission lines across the river on the old railroad piers of the Peoria & Pekin Union Railway.

ROCHELLE, ILL.—The City Council has granted the Flagg Center Tel. Co. a franchise to construct and operate a telephone exchange in this city.

ROODHOUSE, ILL.—J. T. Galloway, of Greenfield, has applied for a franchise to construct and operate an electric system here. Power to operate the system is to be obtained from the power plant on the Mississippi River at Keokuk.

SPRINGFIELD, ILL.—The Springfield Consol. Ry. Co. expects to purchase two 400-hp Stirling boilers for its power plant in Springfield during the next seven months.

WARSAW, IND.—The Kosciusko County Council is considering the question of securing electricity from the Winona power house for lamps and motors at the county infirmary.

ANTHON, IA.—A special election will soon be held to vote on the proposition to issue bonds for the erection of an electric-light plant.

FAIRFIELD, IA.—The city has canceled its contract with the Iowa Pwr. Co., of Oakland, to furnish power to operate the municipal electric system and is now considering plans for improving the municipal power plant or to make a new contract with another power company to furnish the service.

HUMBOLDT, IA.—The Humboldt El. Lt. & Pwr. Co. contemplates extending its system to Rolfe, and a franchise will soon be applied for.

MURRAY, IA.—Steps have been taken to form a company to install and operate an electric-light plant here. F. S. Smith is interested.

OSKALOOSA, IA.—The Oskaloosa & Buxton Ry. Co. is planning to erect a transmission line from Oskaloosa to Sharon, for which, it is understood, materials will soon be purchased, including poles, copper wire, insulators, etc. A. W. Burdick, Oskaloosa, is engineer.

PIERSON, IA.—Bonds to the amount of $4,500 have been voted for the installation of a municipal electric-light plant.

REMSEN, IA.—The contract for the construction of the plant of the Remsen El. Lt. & Pwr. Co. has been awarded to the Alamo Eng. & Sup. Co., Omaha, Neb.

ATCHISON, KAN.—The committee in charge of promoting the installation of an ornamental street-lighting system is considering the installation of a small electric plant, to be installed in the rear of the building occupied by the Fire Department, to supply electricity for the lamps of the proposed "white way."

EVEREST, KAN.—The installation of an electric-light system here is under consideration. It is proposed to obtain electricity for the system from the Horton plant. The cost of the transmission line is estimated at about $7,000.

HUTCHINSON, KAN.—The Hutchinson & Western Interurban Ry. Co. has been granted permission by the Public Utilities Commission to issue $1,000,000 in bonds, the proceeds to be used for the construction of an electric freight and passenger railway from Hutchinson west to Hudson in Stafford County.

BARBOURVILLE, KY.—The Barbourville El. Lt., Ht. & Pwr. Co. has agreed to make improvements to the street-lighting system and will replace the old lamps with new arc lamps. A. Smith is manager.

HENDERSON, KY.—The city of Henderson has contracted with the Henderson Trac. Co. for power, to be furnished at 1 cent per kw-hr.

LEXINGTON, KY.—Plans have been perfected for the organization of the Dix River Pwr. Co., which proposes to construct a 20,000-hp hydroelectric plant on Dix River, near Burgin and High Bridge. It is proposed to build three dams and a reservoir that will form a lake 25 miles long. Electricity generated at the plant will be transmitted to Lexington and Louisville and other cities and towns. L. B. Herrington, Richmond, Ky., is president and Arthur Geisler, engineer, is in charge.

LOUISVILLE, KY.—Plans have been made by the George G. Fetter Ht., Lt. & Pwr. Co. for the installation of ornamental street lamps on Main Street from First to Seventh Street and on Fourth Avenue from Main to Market Street.

MURRAY, KY.—The City Council has appointed a committee composed of H. B. Gilbert, T. Beale and L. M. Overby to take charge of the purchase of equipment for the proposed electric-light plant.

SOMERSET, KY.—The Somerset Milling Co. is preparing to equip its plant, which is now operated by steam power, for electrical operation.

SHREVEPORT, LA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 28, for an electric passenger elevator in the United States post office and court house, Shreveport, La., plans and specifications for which may be obtained at the above office. James Knox Taylor is supervising architect.

VEAZIE, MAINE.—The Bangor Pwr. Co., a subsidiary of the Bangor Ry. & El. Co., has commenced work on the construction of a new reinforced-concrete dam at the Veazie power station to replace the wooden dam in use here. The new dam will be located about 1000 ft. below the old dam and will be capable of developing 33,500 hp. It will be 750 ft. long and will cost about $150,000.

BRUNSWICK, MD.—The city contemplates a $30,000 bond issue for municipal improvements, including an electric-light plant.

FRIENDSVILLE, MD.—Arrangements have been completed by the Youghiogheny Pwr. Co. for the construction of a hydroelectric power plant at Friendsville on the Youghiogheny River, where it is estimated that 40,000 hp can be developed for transmission by electricity to towns and cities in western Maryland and possibly to several cities in Pennsylvania. The cost of the proposed plant is estimated at $4,000,000 and will include three dams and a reservoir 6 miles long. C. L. Pullen, of New York, is vice-president of the company, and Col. John Bogart, 141 Broadway, New York, is engineer. Parties interested in the Youghiogheny Pwr. Co. have organized a company under the name of the Youghiogheny Wtr. & El. Pwr. Co. to build a similar plant at Swallowsville, Md.

HAGERSTOWN, MD.—The Public Service Commission has granted the Frederick & Hagerstown Pwr. Co. permission to issue $300,000 in capital stock and $300,000 in bonds, the proceeds to be used for the construction of a 3000-hp power plant at Security.

HIGHFIELD, MD.—Dr. Joseph Roach contemplates the installation of an electric-light plant to supply electricity for lighting the residences in Highland and possibly in Cascade.

ATHOL, MASS.—The Athol Gas & El. Co. has been awarded the contract to supply electricity for the Templeton street railway to Gardner, including the railway to Gardner and Winchendon.

BELCHERTOWN, MASS.—The Belchertown El. Co. has applied to the Selectmen for permission to erect transmission lines on certain roads in the town for the distribution of electricity.

BEVERLY, MASS.—The installation of a new street-lighting system is under consideration.

CHICOPEE, MASS.—Messrs. McClintock & Craig, of Springfield, Mass., have been engaged by the electric light commissioners to complete the work of rebuilding the municipal electric-light plant.

FALL RIVER, MASS.—The Fall River El. Lt. Co. and the New Bedford Gas & Edison Lt. Co. are promoting the organization of the Southern Massachusetts Pwr. Co., with the object of having this company furnish under contract electricity needed by the two companies. It is proposed to supply electricity to operate the mills in Fall River and New Bedford by the two local companies. A special meeting of the stockholders of the Fall River El. Lt. Co. has been called for April 25 to vote on the ratification act of the board of directors in agreeing to sell to the Southern Massachusetts Pwr. Co. the generating plant, land and adjoining wharf property. The new company is to be capitalized at $1,000,000.

FITCHBURG, MASS.—The City Council has contracted with the Fitchburg Gas & El. Lt. Co. for the installation of an ornamental street-lighting system. The contract provides for the installation of 96 cluster lamps, to be erected on the street-railway poles, to cost $50 per year per cluster. The city will purchase about 20 poles.

GRANBY, MASS.—The Selectmen have been authorized to grant the Central Massachusetts El. Lt. Co., Palmer, a franchise to erect transmission lines to supply electricity for lamps and motors here. An appropriation of $250 has been made for street lamps.

ROCKLAND, MASS.—At a special town meeting held April 8 the proposition to build a municipal lighting plant was carried. This was the preliminary vote, and by law it will have to come before the town at another meeting to be held within a year.

BATTLE CREEK, MICH.—Plans have been prepared by W. G. Fargo, Mich., for the construction of a two-story and basement power house, 50 ft. x 100 ft., for the Commonwealth Pwr. Co., to cost about $100,000. W. A. Potter, Battle Creek, is secretary.

KALAMAZOO, MICH.—At an election held April 1 the proposition to issue $140,000 in bonds to establish a municipal electric-light plant was carried.

REED CITY, MICH.—The dam of the Osceola Lt. & Pwr. Co. was washed away recently, causing a loss of about $3,000. The town will be without electrical service for some time.

DASSEL, MINN.—H. B. Rutledge, Glencoe, contemplates the installation of an electric-light plant here, for which application for a franchise will soon be made.

FERGUS FALLS, MINN.—At an election held April 2 the proposition to rebuild the city dam was defeated. The city will purchase electricity to operate the municipal system.

FOLEY, MINN.—Preparations are being made by Harmon E. Becker for the erection of an electric-light plant here, to cost about $10,000. Bids for construction of plant will be received until May 1.

MOORHEAD, MINN.—Application has been made to the City Council by H. M. Byllesby & Co., Chicago, Ill., which controls the Union Lt., Ht. & Pwr. Co. and the Fargo & Moorhead St. Ry. Co., for franchises for extensions to the local street railway, electric-lighting, gas and water systems.

TERREBONNE, MINN.—E. F. Wheeler, of the Red River Pwr. Co., Grand Forks, N. D., has applied for a franchise to supply electricity here.

BOONEVILLE, MISS.—Plans are being prepared by R. C. Huston, Exchange Building, Memphis, Tenn., for lighting plant, water-works and sewer system. D. W. Robins and others are interested in the project.

SUMNER, MISS.—The city contemplates an issue of $22,500 in bonds, to provide funds for the installation of electric-light plant, water-works and sewer system.

HOLLISTER, MO.—Plans are being made to secure electrical service here from the Ozark Pwr. & Wtr. Co., Ozark, to be supplied from the large plant now being installed on the White River.

GREAT FALLS, MONT.—The creation of a lighting district for the installation of ornamental lamp standards is under consideration by the City Council. The proposed system will consist of 80 standards, of which 31 are erected. The cost of the system is estimated at $10,800, of which it is proposed to have the property owners pay 50 per cent, the city 33⅓ per cent and the street railway company 16⅔ per cent.

LEWISTOWN, MONT.—The City Council has granted D. F. Smith, of Great Falls, a franchise to operate an electric-light system here.

EDGAR, NEB.—Plans are being considered for the construction of a power plant on the Blue River. Bids for construction of same will probably be called about July 1. Earl C. Rickel is city clerk.

GLEN GARDNER, N. J.—Preparations are being made for the erection of a power plant for the New Jersey Sanitarium for Tuberculous Diseases in Glen Gardner. The plant will be located in Rocky Run, about half a mile from the sanitarium buildings.

TRENTON, N. J.—The Pennsylvania R. R. Co. is reported to have decided to erect a new passenger station on East State Street. The plans include the erection of an electric power plant to furnish power to operate the switches, signals, lamps, etc., at a cost of about $80,000.

AMSTERDAM, N. Y.—A special committee has been appointed by the City Council to look into the question of utilizing the water-power now going to waste at the conduit line just above the city reservoir for the purpose of generating electricity to light the city.

BROADALBIN, N. Y.—The Broadalbin El. Lt. & Pwr. Co. has purchased the property of the Northville El. Lt. Co. and will take possession May 1. Electrical service in Northville will be supplied from the Broadalbin plant and a 24-hour service will be established.

BUFFALO, N. Y.—The Board of Aldermen has authorized an issue of $50,000 in bonds to place the police and fire wires underground.

CANISTEO, N. Y.—The Village Council is negotiating with the Hornell El. Co., Hornell, with a view to lighting the streets of the village with electricity. At present the streets are lighted by gas supplied by the Canisteo Gas Co.

GREENPORT, N. Y.—The Albany Southern R. R. Co., Hudson, has petitioned the Public Service Commission for permission to extend its transmission line to Greenport and to exercise rights and privileges granted by the village authorities to supply electricity here.

LYONS, N. Y.—Two propositions for the installation of a municipal electric-light system have been submitted to the Village Board. It is proposed to secure electricity for operating the system from either the Rochester, Syracuse & Eastern R. R. Co., Syracuse, or the Niagara, Lockport & Ontario Pwr. Co., Buffalo. The cost of installing a system, energy to be supplied by the Rochester, Syracuse & Eastern R. R. Co., would cost about $10,000, while the installation of a plant to be operated by electricity furnished by the Niagara, Lockport & Ontario Pwr. Co. would cost about $15,000, the extra cost being for machinery for transforming the current. The proposition to install the plant will soon be submitted to the voters.

NEW YORK, N. Y.—The New York Athletic Club has decided to install a power plant in the club house in the near future, to cost about $100,000.

NEW YORK, N. Y.—Sealed bids will be received until May 27 for the sale of discarded power plant equipment at the navy yard, New York, consisting of Davidson & Blake pumps, Ingersoll-Sergeant air compressors, McIntosh-Seymour engines, Wheeler water filters and heaters, Westinghouse generating sets and motors, etc. Schedules containing forms of proposals and terms of sale can be obtained upon application to the board of sale, navy yard, New York. Beekman Winthrop is assistant secretary of navy.

OSWEGO, N. Y.—The installation of an ornamental lighting system in the business district is under consideration. The cost of installing the system is estimated at about $18,000. The People's Gas & El. Co. agrees to bear the cost of installing the system provided the merchants will sign a five-year contract. It is proposed to use magnetite arc lamps of 2000 cp. R. F. Whitney is manager of the company.

ROCHESTER, N. Y.—Rochester Ry. & Lt. Co. will furnish electricity for the construction of the West Side sewer to run 1500 ft. from the Genesee River to Glenwood Avenue. Large electric hoisting machines will excavate dirt from the ditch.

ROCHESTER, N. Y.—The New York State Rys. Co., Rochester lines, is erecting a substation on the site of the Charlotte car barns, which will supply electricity for the Charlotte and Summerville lines. Besides the 750-kw generator that was in the old building the station will be equipped with a 1400-kw generator. A 10-ton crane will also be installed. The station will ultimately have an output of 5000 hp.

SYRACUSE, N. Y.—The Municipal Htg. Co., which is being reorganized under the name of the Syracuse Utilities Co., proposes to supply electric current for heating business places and residences in Syracuse. The company proposes to equip the old steam-heating plant, located on the Erie Canal, near the Oswego Canal, to generate electricity and to utilize the underground conduits which were formerly used for distribution of steam. William H. Stansfield, Douglas N. Green, J. F. Durston, Albert B. Keer and others are interested.

ALBEMARLE, N. C.—Boston capitalists are interested in a proposition to develop a hydroelectric power plant on the Yadkin River, a few miles below the Whitney plant. The cost of the project is estimated at about $3,000,000. Charles Armstrong, of Troy, represents the syndicate.

CHARLOTTE, N. C.—Application has been made to the City Council by John R. Purser and Sterling Graydon for a franchise for a central light, power and heating plant. The proposed plant will cost about $75,000.

CHARLOTTE, N. C.—The Charlotte Rapid Transit Co. is planning to build a power plant near the Country Club for the purpose of supplying electricity in that section. The company expects to extend the railway from Elizabeth College to Fourth Street, thence west to the union station.

GOLDSBORO, N. C.—The Carolina Pwr. Co. is negotiating for the purchase of the municipal electric-light plant, together with a franchise to supply electricity for lamps and motors here. The company offers $90.000 for the plant, but the city wants a higher price. If the deal is consummated, the company will extend its transmission lines from Raleigh to Goldsboro.

MAYVILLE, N. D.—The City Council is contemplating remodeling the municipal electric-light plant or building an entirely new plant. The cost of a new plant is estimated at $15,000.

WASHBURN, N. D.—The installation of an electric-light plant in Washington is under consideration by the Commercial Club.

CINCINNATI, OHIO.—The Union Gas & El. Co. is planning to erect a substation at the corner of Myrtle Avenue and Preston Street, Walnut Hills, to cost about $18,000.

CLEVELAND, OHIO.—Sealed proposals will be received at the office of the Director of Public Service, City Hall, Cleveland, until April 24 for constructing an aqueduct for the municipal electric-light plant, plans and specifications for which may be secured at the office of the construction engineer, room 319, city hall. W. J. Springhorn is director of public service.

FREMONT, OHIO.—The City Council has authorized Service Director Sneider to advertise for bids for street lighting for a period of ten years, bids to be opened June 18.

MOUNT CORY, OHIO.—Bonds to the amount of $12,000 have been voted for the purpose of establishing a municipal electric-light plant.

DURANT, OKLA.—Bonds to the amount of $5,000 have been voted for extensions to the municipal electric-light plant.

OKEMAH, OKLA.—The Canadian Pwr. & Lt. Co. contemplates the construction of a hydroelectric plant, to be located about 7 miles from Okemah. The plant will cost about $50,000 and will develop about 2000 hp.

CORVALLIS, ORE.—The Portland, Eugene & Eastern Ry. Co. contemplates the construction of an electric railway from Corvallis to Albany, a distance of 10 miles.

ELGIN, ORE.—The City Council has granted the Eastern Oregon Lt. & Pwr. Co., Baker City, a franchise to install an electric-light system here, work on which will begin at once. F. A. Harmon, Baker City, is manager.

FAIRVIEW, ORE.—The Portland Ry., Lt. & Pwr. Co. is erecting a distributing system in Fairview.

HUNTINGTON, ORE.—The U. S. Smelting & Mining Co. has made arrangements with James A. Howard, of Baker City, to supply electricity to the Humboldt and Rainbow mines.

PORTLAND, ORE.—The West Coast Engineering Co. has been awarded a contract for the erection of lamp posts and installation of brackets for an outline system of lamps on the Burnside and Hawthorne bridges, at a cost of $10,528. The contract for erecting electric lamps on the Morrison bridge was awarded to the Northwest Electrical Co., Portland, at $3,837.

SALEM, ORE.—The Southern Pacific Co. has filed an application with the State to appropriate the water rights on the McKenzie River at Cedar Lake. The company, it is said, will erect a power plant on the site.

ELLWOOD CITY, PA.—The Republic Ry. & Lt. Co. has secured control of the Pennsylvania Pwr. Co., which supplies electrical service in Ellwood City, borough of West Pittsburgh, borough of Wampum and to the Zelienople Lt. & Pwr. Co. The lines of the two companies will be connected.

MAHANOY CITY, PA.—Plans and specifications are being prepared by the Scofield Engineering Co., Philadelphia, Pa., consulting engineers, for remodeling the present generating station of the People's Lt., Ht. & Pwr. Co. in Mahanoy City into a large substation, work on which will soon begin.

PINE GROVE, PA.—A proposition has been submitted by Mr. Troxell to the Town Council asking for a franchise to install and operate an electric-light plant. Mr. Troxell asks for a street-lighting contract amounting to $1,200 per year.

PITTSBURGH, PA.—The Pennsylvania Pwr. Co., recently incorporated, has filed a notice of an increase in capital stock from $5,000 to $400,000.

PITTSBURGH, PA.—The litigation among those interested in the Pittsburgh & Allegheny Tel. Co. has ended and the company has been reorganized. Steps are being taken to dissolve the receivership and acquire the independent telephone plant at Washington, Pa. Dr. John L. Dickey, of Wheeling, W. Va., is president.

RIDGWAY, PA.—The Town Council has made arrangements with the Ridgway El. Co. for the installation of an electric street-lighting system.

TRUMBAUERSVILLE, PA.—The Lehigh Valley Transit Co., Allentown, has submitted a proposition to the Borough Council for lighting the streets of the borough with electricity.

NASHVILLE, TENN.—The Tennessee Ry., Lt. & Pwr. Co. is being organized to control the Nashville Ry., Lt. & Pwr. Co., the Chattanooga Ry. & Lt. Co., the Eastern Tennessee Pwr. Co. and other water-power interests on which options were recently taken by H. M. Byllesby & Co., of Chicago, Ill., and others. The company will be capitalized at $18,750,000. The plans include further development of the water-powers purchased, which aggregate possibilities of 160,000 hp, of which 20,000 hp has been developed, and plans are being prepared for the development of 30,000 hp; also for the erection of transmission lines to Nashville, Chattanooga and Knoxville, Tenn.; Rome, Ga., and other cities, and ultimately to Louisville, Ky., and Cincinnati and other cities in Ohio.

AUSTIN, TEX.—The City Wtr. Pwr. Co., of Hartford, Conn., which is to rebuild the large dam on the Colorado River, in Austin, has taken out a permit to do business in Texas. The contract provides for an enlarged and more efficient water, light and power plant for the city, work on which has already commenced. William D. Johnson, of Hart-

ford, is interested in the company. Frank S. Taylor has charge of the construction of the dam.

FRANKSTON, TEX.—Steps have been taken toward the installation of an electric-light plant in Frankston.

SAN ANGELO, TEX.—The San Angelo Wtr., Lt. & Pwr. Co. has increased its capital stock from $225,000 to $500,000, the proceeds to be used for extensions and improvements to its system.

SALT LAKE CITY, UTAH.—The Utah Lt. & Ry. Co. will make extensive additions to its power and transmission systems during the present year.

CHEWELAH, WASH.—Investigations are being made by the Washington Water-Power Co. with a view of extending its transmission line from the Little Falls plant to Chewelah, a distance of 42 miles. The company has submitted a proposition to the Council to take over the municipal plant and increase the same to meet the requirements of the town. The immediate demands will require about 1000 hp, of which the United Copper Mining Co. will take 600 hp.

CONCONULLY, WASH.—The Nixon-Kimmel Co. has been granted a franchise to extend its transmission lines to Pateros and Brewster to supply electricity for lamps.

KALAMA, WASH.—The City Council has awarded the Washington-Oregon Corporation a contract for street lighting for a period of five years. The contract provides for 25 arc lamps. The arc lamps now in use will be discarded and new ones installed.

SULTAN, WASH.—The Council has granted F. I. Anderson a 25-year franchise to install and operate an electric-light plant here. Power for operating the plant is to be obtained from a creek near the Great Northern mill.

FOLLANSBEE, W. VA.—The Tri-State Amusement Co. is planning to install a power plant in the basement of its proposed new theater to supply light and heat for the building.

MORGANTOWN, W. VA.—The Mountain State Land Co. has purchased 205 acres of additional land on Cheat River, which it is preparing to develop for water-power.

FOND DU LAC, WIS.—The city water commission is considering the question of taking over the arc-lamp street-lighting system and operating same by electricity generated at the pumping station of the city water works. The plan also involves the installation of an ornamental street-lighting system.

MANITOWOC, WIS.—The Aluminum Castings Co. is planning to build an addition to its plant here, work on which will begin at once. The company will install its own power plant.

MARSHFIELD, WIS.—Extensive improvements and extensions are contemplated to the Marshfield telephone exchange this summer, which will involve an expenditure of about $15,000 and include a new switchboard, 2500 ft. of cable and over 100 new poles. J. C. Marsh is owner.

RACINE, WIS.—The J. I. Case Threshing Machine Co. is planning to build a central power plant on Ontario Street, at a cost of about $75,000.

STURGEON BAY, WIS.—The contract for extending the transmission lines from the northern city limits to the summer colony on Shoreside, a distance of about 3 miles, has been awarded to Louis Nebel, electrical contractor.

TWO RIVERS, WIS.—Bids will be received until April 25 for extensions to the municipal water and light plant. The cost of the work is estimated at about $15,000. Vaughn & Meyer, engineers, Majestic Building, Milwaukee, Wis., have charge of the work.

WAUWATOSA, WIS.—The Board of County Supervisors has engaged Eugene McAlear, of Chicago, engineer, to prepare plans and estimates of the cost of establishing a central power and lighting plant for the county buildings at Wauwatosa.

LANDER, WYO.—Sealed bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 29, for an electric elevator in the United States post office, Lander, Wyo., plans and specifications for which may be obtained at the above office. James Knox Taylor is supervising architect.

LARAMIE, WYO.—The Greeley Hydro-Electric Co., of Greeley, Col., has submitted a proposition to the city offering to supply electricity at 1½ cents per kw-hr. on a long-time contract.

CRANBROOK, B. C., CAN.—The Canadian Pacific R. R. Co. is building a large dam on the Bull River, near Cranbrook. Electricity will be transmitted to towns in the Crow's Nest as far east as Hosmer and west to Cranbrook, Moyie and Fort Steele. A large sawmill is also being erected there by the company.

CUMBERLAND, B. C., CAN.—Extensive developments are under way by the Canadian Colliers (Dunsmuir), Ltd., in connection with its properties in the Comox district, which include the building of a new railway from the Trent River to the new No. 8 shaft, and rebuilding of a portion of the present line at a cost of $850,000, and the construction of a hydroelectric plant, work on which has commenced, to replace the present steam power with electricity. The cost of the hydroelectric plant is estimated at $750,000.

HASTINGS, B. C., CAN.—The Western Canada Pwr. Co. has applied for a franchise to supply electricity for lamps and motors in Hastings.

TYNDALL, MAN., CAN.—The Municipal Light and Power Department of Winnipeg is making arrangements to erect a substation at Carson Quarries, near Tyndall. M. Peterson is secretary.

FORT ERIE, ONT., CAN.—The Canadian Niagara Pwr. Co. is planning to enlarge its power plant here this spring. A transmission line will be erected to Erie and Crescent Beach, where a new lighting system will be installed. The Erie Beach Railroad will be equipped for electrical operation and probably double-tracked. Contracts for the work will soon be awarded.

OTTAWA, ONT., CAN.—It is stated that negotiations are under way between the Hydro-Electric Commission and the Dominion government whereby the locks and canals along the St. Lawrence River will be lighted by electricity.

PETERBOROUGH, ONT., CAN.—The Legislature has granted the city of Peterborough authority to expropriate the plant of the Peterborough Lt. & Pwr. Co., to be owned and operated by the municipality. It is proposed to secure power from the Hydro-Electric Commission.

ST. MARY'S, ONT., CAN.—The Town Council has decided to take 1200 hp from the Hydro-Electric Power Commission. Equipment will be required for the new system. For further information address E. J. Stapleton, superintendent.

WINDSOR, ONT., CAN.—The Windsor Brass Mfg. Co. has purchased the Ferris property and proposes to remodel the buildings and equip power plant. W. D. Murray is manager.

WATROUS, SASK., CAN.—The Watrous El. Lt., Pwr. & Trac. Co., it is reported, contemplates doubling the output of its plant.

New Industrial Companies

THE AMERICAN TELETYPE COMPANY, of Wyandanch, N. Y., has been incorporated with a capital stock of $10,000 to manufacture machinery for communication. The incorporators are: John McLaren, E. J. Forhan and F. B. Knowlton, all of 154 Nassau Street, New York.

THE APPLE ELECTRIC COMPANY, of Dayton, Ohio, has been incorporated with a capital stock of $300,000 to manufacture and deal in electrical equipment. The incorporators are: V. G. Apple, Oscar Apple, J. C. Slager, Clarence Kiefer and Carl L. Baumann.

THE CARL BOENSCH MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $2,500 to manufacture and deal in electrical fixtures. The incorporators are: Carl Boensch, Walter L. Jensen and F. Getz.

THE CENTRAL CALIFORNIA TELEPHONE HERALD COMPANY, of Sacramento, Cal., has been incorporated with a capital stock of $100,000 for the purpose of operating "central stations" from which music, songs, recitals, lectures and sermons will be sent over telephone wires to subscribers.

THE ELECTRIC GOODS COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $15,000 by Frank R. Duguny, Earl V. Stacey, Edward Younger, C. C. Corell and L. LaFramboise.

THE ELECTRIC VEHICLE MAINTENANCE COMPANY, of San Francisco, Cal., has been incorporated with a capital stock of $10,000 by R. Scrama, R. H. Robinson and O. W. Lillard.

THE EXTENSIVE MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $150,000 for the purpose of manufacturing vending machines, mechanical and electrical devices, etc. The incorporators are: T. G. Jenkins, P. E. Seib and A. F. Bucher, all of New York.

HALBERT P. HILL, INC., New York, N. Y., has been incorporated with a capital stock of $50,000 to manufacture electrical machinery, etc., by H. P. Hill, M. W. Atkinson and A. M. Heritage, of New York, N. Y.

THE INDELECTRIC MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing electric batteries, etc., by J. McLaren, E. J. Forhan and F. B. Knowlton, all of 154 Nassau Street, New York, N. Y.

THE INTERSTATE ELECTRIC NOVELTY COMPANY, of New York, N. Y., has been incorporated by A. Wolff, New York, N. Y.; S. I. Posen and M. L. Kaplan, both of Brooklyn. The company is capitalized at $130,000 and proposes to manufacture machinery, appliances, electrical supplies, etc.

THE KEYSTONE NATIONAL ELECTRIC COMPANY, of Hoboken, N. J., has been incorporated by D. F. Plahn, Hoboken; C. W. Shaffer and R. K. Mickey, of New York, N. Y. The company is capitalized at $600,000 and proposes to manufacture incandescent lamps, electrical apparatus, machinery, etc.

THE LANG-HARRAL CORPORATION, of Boston, Mass., has filed articles of incorporation with a capital stock of $65,000 to manufacture and deal in electric devices, etc. The directors are: Harry G. Vinal, president; Clarence E. Lang, of Winthrop, Mass., treasurer, and James H. Canney.

THE MAXIVOLT PRIMARY BATTERY COMPANY, of Jersey City, N. J., has been granted a charter with a capital stock of $500,000 for the purpose of manufacturing batteries, electric horns, speedometers, motors, etc. The incorporators are: W. C. Parker, A. H. Sands, Jr., and J. S. Prall, of Jersey City, N. J.

New Incorporations

LOS ANGELES, CAL.—Articles of incorporation have been filed for the Potter El. Co. with a capital stock of $100,000 by L. C. Haynes, S. P. Troad and J. R. Kinney.

HARTFORD, CONN.—The City Wtr. Pwr. Co. has been incorporated with a capital stock of $2,000 and the following officers: H. B. Freeman, Jr., president; Henry H. Hunt, Glastonbury, vice-president; Thomas C. Burne, Hartford, treasurer, and Charles F. Roberts, New Haven, secretary.

SAVANNAH, GA.—The Savannah Pwr. Co. has been incorporated with a capital stock of $1,000,000 by George J. Baldwin, Marcy L. Sperry and others. The company will own the new plant being built for the Savannah El. Co.

LAFAYETTE, LA.—The Louisiana El. Ry. & Pwr. Co. has been organized with a capital stock of $2,000,000 to construct an electric power plant and railway. The main plant will be located at Lafayette with auxiliary stations at New Iberia and Abbeville. The railway will run from New Iberia to Lafayette, thence to Abbeville and back to New Iberia, covering a distance of 100 miles. Electricity will be supplied for public and private industries along the line. The officers are: A. G. Barraw, of New Iberia, president; E. H. Campbell, New Orleans, vice-president; Albert J. Broussard, of Lafayette, secretary and treasurer, and Anderson Offutt, New Orleans, electrical engineer.

POLSON, MONT.—The Flathead Pwr. & Trac. Co. has been chartered with a capital stock of $150,000 for the purpose of building an electric railway from Polson to Dixon. The directors are: F. L. Gray, C. R. M. Stritzel, T. R. Arnold, F. F. Faucett, M. A. Myhre and A. W. Pipes, all of Polson.

ASHEVILLE, N. C.—The Asheville Pwr. & Lt. Co. has been incorporated with a capital stock of $2,000,000 by H. H. Carr, H. P. Dalton and F. H. Briggs, of Raleigh, N. C. The new company, it is understood, will take over the Asheville street railway lines and the electric-lighting system and also proposes to develop hydroelectric plants in Western Carolina to supply electricity in Asheville and other towns in this part of the State.

MAXTON, N. C.—The Maxton Lt. & Pwr. Co. has been granted a charter with a capital stock of $50,000 for the purpose of building an electric plant. J. J. Kincaid is president and W. M. Kincaid secretary and treasurer.

NAPOLEON, OHIO.—The Napoleon Tel. Co. has been incorporated with a capital stock of $50,000 for the purpose of taking over the property of the Napoleon Home Tel. Co. The incorporators are: W. L. Permenter, Wallace Landis, B. B. Applas, M. Brenneman and John L. Cable.

CORAOPOLIS, PA.—The Coraopolis & Woodlawn Interurban Ry. Co. has been incorporated to build an electric railway between Coraopolis and Woodlawn, a distance of 10 miles. The company is capitalized at $60,000 and the incorporators are: E. C. Dithrich, Coraopolis, president; C. B. Ferguson, W. J. Dithrich, J. W. Arrow, of Coraopolis, and others.

HARRISBURG, PA.—Charters have been granted by the State Department to the Unionville El. Co., the Howard El. Co. and the Milesburg El. Co. Each company is capitalized at $5,000 and the directors are: John W. Wrigley, treasurer; A. W. Lee and A. J. Musser, all of Clearfield, Pa.

HARRISBURG, PA.—Charters have been granted by the State Department to the Jefferson, West Salem, Delaware, Fredonia, Cool Spring and Hempfield El. Lt., Ht. & Pwr. Cos. Each company is capitalized at $5,000. These companies will supply electricity to farmers in the upper end of the county. Power stations will be erected in Greenville, Mercer and Jamestown.

SPARTANBURG, S. C.—The Spartanburg & Glenn Springs R. R. Co. has been chartered with an initial capital stock of $100,000, to be increased to $250,000, to build an electric railway from Spartanburg to Glenn Springs, 14 miles long. The incorporators are: J. B. Lee, J. T. Harris, N. F. Walker, W. H. Herring, A. M. Law, F. H. Knox, F. L. Liles and J. Wright Nash.

NASHVILLE, TENN.—The East Tennessee Trac. Co. has been incorporated by J. W. Adams, George B. Adams, B. C. Roper, Lewis M. Coleman and William L. Frierson. The company is capitalized at $100,000 and proposes to build an electric railway from Cleveland to Chattanooga, a distance of about 30 miles.

FLORESVILLE, TEX.—The Floresville Ice & Pwr. Co. has been organized with a capital stock of $1,650,000 by W. G. E. Rolaff, Richard Wolfsky and Yale Hicks.

SWEETWATER, TEX.—The Sweetwater Lt. & Pwr. Co. has been granted a charter with a capital stock of $50,000. The incorporators are: L. L. Stephenson, W. J. Fulwiler and H. F. Carroll.

WHITEWRIGHT, TEX.—A charter has been granted to the Greenville & Whitewright Northern Trac. Co. with a capital stock of $210,000 to build an interurban electric railway to connect Greenville and Whitewright and intervening towns. The incorporators are: A. R. Nicholson, J. W. Castleberry, H. A. Barsun, A. W. Defee, J. E. Morris and W. H. James, of Greenville, and S. M. Dickens, of Merit.

Trade Publications

THREE-WIRE GENERATORS.—Three-wire direct-connected generators are described, together with their principle of operation, in a sixteen-page circular (No. 1088) issued by the Westinghouse Electric & Manufacturing Company. Numerous views of applications, together with diagram of connections and views of the component parts, are given.

ELECTRIC HEATING AND COOKING.—The General Electric Company has issued Bulletin No. 4921, relative to electric heating and cooking appliances and their application to the home, office and factory. The bulletin is printed in two colors on heavy-coated stock and has a very attractive embossed cover. Many of the various devices are shown in use. The publication contains also a section devoted to wiring plans and wiring devices for the home.

MOTORS FOR CRANE AND HOIST SERVICE.—Descriptive Leaflet No. 2443 issued by the Westinghouse Electric & Manufacturing Company gives curves which show the performance of both direct-current series-wound and alternating-current-wound rotor crane motors. These curves show temperature rise, horse-power, torque, efficiency and other points of interest in the operation of this class of motors. The descriptive matter explains the curves and their applications and gives the specifications for motors of this class.

CENTRIFUGAL PUMPS.—The Goulds Manufacturing Company, Seneca Falls, N. Y., has issued Bulletin No. 110, covering a new line of single-stage, double-suction centrifugal pumps. The bulletin gives a short history of the centrifugal pump, construction details, lists of sizes and weights of pumps and accessories, table showing power required for various sizes of pumps, losses due to friction, etc. It also includes photographs of and information in regard to various kinds of installations. A list of data required for estimates will be found useful.

INTERNAL-COMBUSTION ENGINES FOR MARINE SERVICE.—The Aktiebolaget Diesels Motorer, Stockholm, Sweden, has issued a set of descriptive circulars of vessels equipped with the "Marine-Polar" engines built by this company. The circulars are printed in four languages—Swedish, English, French and German—and are illustrated with photographs showing exterior and interior views and, in some cases, plan and sectional views of the vessels. According to a list of installations, the first vessel was equipped in 1904, and the sizes vary from 60 hp to 350 hp. Installations have been made on various kinds of vessels, such as passenger boats, freighters, tugs, pleasure yachts, whalers, ice-breaking tugs, motor-equipped sailing vessels, etc., and, according to testimonies from the purchasers, with equal success. In each description are included the general dimensions of the vessel and size and speed of the engine. Among the vessels equipped may be mentioned Amundsen's polar ship *Fram* and the freighter *Toiler*. The latter crossed the Atlantic Ocean last October and was the first motor-propelled vessel to make this trip.

Business Notes

THE STRAIGHT FILAMENT LAMP COMPANY has moved its office and salesroom to 125 West Forty-second Street, New York.

THE ALLEN-BRADLEY COMPANY, Milwaukee, Wis., has purchased the rheostat department of the American Electric Fuse Company, Muskegon, Mich., including all drawings, patterns, tools, dies, engineering data, patents, copyrights, trade-marks, good-will, books of account, mailing list and other records.

TAYLOR STOKERS.—The New York Edison Company has recently purchased from the American Engineering Company, Philadelphia, thirty-four more Taylor stokers with extension grates for its Waterside station. This is the fifth order for Taylor stokers, making 115 stokers of this type in the two Waterside stations.

THE CENTRAL TUBE COMPANY, OF PITTSBURGH, TO MANUFACTURE INTERIOR CONDUIT.—The Central Tube Company, Pittsburgh, has erected a large conduit factory opposite its pipe mills and installed the most modern equipment for making interior electrical conduit. It is at present manufacturing an electro-galvanized pipe, which is being placed upon the market under the trade name of "Central white," and an enameled conduit under the trade name of "Central black." In special cases where conditions are found to be too severe for either of the above-mentioned pipes it supplies an electro-galvanized conduit with a red enamel inside and outside, under the trade name of "Central red."

REMOVAL OF SIMPLEX OFFICES IN CHICAGO.—The Simplex Electrical Company, manufacturer of insulated wires and cables, has removed its Chicago offices and warehouse from the Monadnock Building to the building at 15-21 South Desplaines Street. This is in the "electrical district" of the West Side, and the new location will enable the company to carry a much larger stock in Chicago. Mr. H. R. Hixson, Western selling agent for the company, will be in charge, as for a number of years past. The Simplex Electric Heating Company has also moved into the same building, and Mr. E. R. Jacobs will continue in charge of that company's Chicago business. The offices of both companies will be on the third floor, and there will be extensive display rooms.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 9, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,022,423. BRANCH BLOCK FOR ELECTRIC MOLDINGS OR CONDUITS; G. A. Jordan, New York, N. Y. App. filed April 28, 1910. Recessed porcelain block.

1,022,426. ARC-LIGHT ELECTRODE OR PENCIL; I. Ladoff, Cleveland, Ohio. App. filed Feb. 12, 1908. An iron tube filled with powdered iron and oxide of titanium.

1,022,482. FILAMENT CONNECTION; J. W. Howell, Newark, N. J. App. filed Aug. 7, 1907. A tungsten filament joint is sintered with copper paste.

1,022,487. ELECTROPLATING APPARATUS; G. S. Lutz, Plainfield, N. J. App. filed Jan. 7, 1911. For plating pipes inside and outside.

1,022,497. ALARM APPARATUS; J. D. Nelson and E. F. Smith, Cincinnati, Ohio. App. filed March 3, 1910. For automatic fire-extinguishing sprinkler systems; pressure indication.

1,022,517. ELECTRICAL MEASURING INSTRUMENT; E. Thomson, Swampscott, Mass. App. filed July 30, 1908. Strong torque and open and uniform scale.

1,022,519. TELEPHONE REPEATER; N. G. Warth, Columbus, Ohio. App. filed Jan. 28, 1910. Utilizes the "page effect" for long-distance work.

1,022,522. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Dec. 28, 1907. Double-acting relays jointly controlled by the subscribers and operators.

1,022,523. CONCENTRATION OF SOLIDS IN LIQUIDS; W. R. Whitney, Schenectady, N. Y. App. filed April 2, 1910. For separating solid matter from a liquid such as casein and cream from milk.

1,022,532. TIME-CONTROLLED ELECTRIC SWITCH; C. M. Crook, Chicago, Ill. App. filed March 12, 1908. For time stamps, etc.

1,022,536. SNAP SWITCH; P. C. De Reamer, Schenectady, N. Y. App. filed July 17, 1908. Rotary button with indicator.

1,022,539. RECEIVER FOR ELECTROMAGNETIC WAVES; R. A. Fessenden, Washington, D. C. App. filed May 4, 1904. A movable liquid electrolytic cathode and a pointed anode.

1,022,540. WIRELESS SIGNALING; R. A. Fessenden, Brant Rock, Mass. App. filed April 5, 1907. Combined multiplex wireless telegraphy, telephony, etc.

1,022,541. ARC LAMP; R. Fleming and E. J. Guay, Swampscott and Lynn, Mass. App. filed Feb. 15, 1907. Ventilation of flaming arcs.

1,022,543. HOLDER FOR LAMP FILAMENTS; L. Glaser, Berlin, Germany. App. filed March 13, 1907. Has a surface of thorium oxide on a stronger oxide core.

1,022,545. ELECTRIC OVEN; J. G. Gronberg and W. D. Hodson, Grand Rapids, Mich., and Janesville, Wis. App. filed Feb. 15, 1909. Fireless-cooker type with the heating-coil and circuit-controlling devices.

1,022,546. TROLLEY FROG; F. Guillot, Schenectady, N. Y. App. filed Aug. 3, 1898. Detachable and interchangeable tongues for attachment to the wires.

1,022,553. METHOD OF FUSING LAMP FILAMENTS TO LEADING-IN WIRES. J. W. Howell, Newark, N. J. App. filed March 16, 1907. A tungsten filament is fused to a copper wire.

1,022,554. WELDING FILAMENTS TO METAL WIRES; J. W. Howell, Newark, N. J. App. filed March 16, 1907. Copper and iron are used in a joint between tungsten and a conductor.

1,022,561. ELECTROPLATING APPARATUS; G. A. Lutz, Plainfield, N. J. App. filed Jan. 7, 1911. A series of tanks and apparatus for plating tubes.

1,022,584. METHOD OF DETERMINING FREQUENCY OF PERIODIC IMPULSES; R. A. Fessenden, Brant Rock, Mass. App. filed July 8, 1903. Electromagnetic wave measurement.

1,022,605. TRAIN-STAFF SYSTEM; V. K. Splicer and V. I. Smart, Montreal, Canada. App. filed Nov. 9, 1909. The "staffs" are in the form of rings supplied in controlled magazines.

1,022,619. HORN-GAP SWITCH AND LIGHTNING ARRESTER; A. W. Burke, Pittsburgh, Pa. App. filed April 2, 1910. For opening high-tension circuits under load.

1,022,628. MECHANISM FOR ACTUATING ELECTRICAL SWITCHES; B. D. Horton, Detroit, Mich. App. filed Oct. 23, 1911. A time switch and fuse in a system for actuating compound switches such as a three-phase motor starter.

1,022,629. ELECTRICAL SWITCH; A. H. Kling and B. D. Horton, Detroit, Mich. App. filed July 11, 1911. For paralleling fuses during brief overloads.

1,022,634. ELECTRIC SEARCHLIGHT FOR AUTOMOBILES. C. A. Lewis, Denver, Col. App. filed Aug. 8, 1910. Arc-lamp mechanism

1,022,644. REMOTE CONTROL APPARATUS; W. M. Scott, Philadelphia, Pa. App. filed June 29, 1910. Circuit-breaker and a motive device for actuating it.

1,022,666. ELECTRICALLY OPERATED DRIVING GEAR; J. A. Essberger, Berlin-Schöneberg, Germany. App. filed Oct. 4, 1910. A plurality of motors are geared to a main shaft by different speed ratios.

1,022,695. ELECTROLYTIC RECTIFIER; W. Morrison, Des Moines, Ia. App. filed Oct. 14, 1910. An anode contains bismuth and the electrolyte contains a soluble potassium chromate.

1,022,707. SOLENOID CONTROLLER; F. W. Smith, Westfield, N. J. App. filed April 5, 1910. Motor starter.

1,022,712. METHOD OF UNITING METAL; E. Thomson, Swampscott, Mass. App. filed March 14, 1910. For welding a rim unto a hub.

1,022,713. TELEPHONE SYSTEM; F. C. Unger, St. Louis, Mo. App. filed March 1, 1911. Local battery or magneto telephone system.

1,022,717. LIGHTNING ARRESTER; A. J. Wurtz, Pittsburgh, Pa. App. filed Jan. 9, 1911. Plurality of pairs of electrodes connected in multiple, each pair comprising a fuse.

1,022,742. INDICATOR-ACTUATING MECHANISM; O. E. Kellum, Los Angeles, Cal. App. filed Nov. 23, 1910. Magnetically controlled step-by-step mechanism for a station indicator.

1,022,794. SUPPORT FOR ARTICLES TO BE ELECTROPLATED; G. A. Lutz, Plainfield, N. J. App. filed Feb. 2, 1911. For supporting the end of a tube from the inside.

1,022,795. ELECTRICAL MEASURING INSTRUMENT; C. McClair, Schenectady, N. Y. App. filed Jan. 21, 1909. Moving-coil type and stationary permanent magnets.

1,022,809. ELECTRIC SWITCH; L. B. Abbott, Bridgeport, Conn. App. filed June 26, 1911. Pull switch.

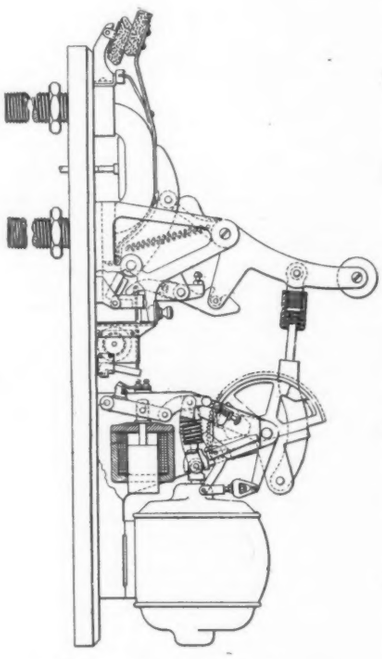
1,022,815. SEPARABLE ATTACHMENT PLUG; R. B. Benjamin, Chicago, Ill. App. filed Nov. 21, 1908. The circuit may be made after the parts are assembled.

1,022,834. ELECTRICAL FUSE; S. F. Estell, Florence, Cal. App. filed Nov. 2, 1910. Rechargeable cartridge-type.

1,022,848. ELECTRIC PROTECTIVE CIRCUIT; O. Jacobson, Hamilton, Ohio. App. filed Sept. 1, 1908. For safes and vaults, etc.

1,022,853. SUPPORT FOR ARTICLES TO BE ELECTROPLATED; G. A. Lutz, Plainfield, N. J. App. filed Jan. 7, 1911. Supports a tube from the lower end.

1,022,880. CURRENT TRANSFORMER; L. M. Schmidt, Lynn, Mass. App. filed Sept. 11, 1908. May be connected to give different ratios; for meters, etc.



1,022,644.—Remote-Control Apparatus.

1,022,897. RESISTANCE UNIT; G. E. Stevens, Lynn, Mass. App. filed Oct. 2, 1908. A plurality of connected spirals in different planes.

1,022,904. CENTRIFUGAL SWITCH; C. J. Webster, Lynn, Mass. App. filed July 31, 1909. For small single-phase induction motors.

1,022,906. ELECTRIC-LAMP SOCKET; H. Wheeler, Hartford, Conn. App. filed March 10, 1909. Transparent socket of a "rosette" type.

1,022,907. CONTROL OF ELECTRICALLY OPERATED SWITCHES; H. E. White, Schenectady, N. Y. App. filed Oct. 15, 1910. Auxiliary switch control. Improvement on Cubitt patent, No. 941,408.

1,022,908. SYSTEM OF MOTOR CONTROL; M. A. Whiting, Schenectady, N. Y. App. filed Aug. 23, 1911. A plurality of induction motors for operating alternately, driving, for instance, the lifting table of a three-high rolling mill.

1,022,910. MANUFACTURE OF QUARTZ APPARATUS; W. R. Whitney, Schenectady, N. Y. App. filed Jan. 7, 1908. Quartz is melted and cast in a vacuum.

1,022,912. TRANSFORMER TERMINAL; E. G. Winston, Pittsfield, Mass. App. filed May 28, 1909. Compound terminal with parallel conductors and detachable connectors.

1,022,917. MOTOR-CONTROL SYSTEM; T. Von Zweigbergk, Southport, England. App. filed Jan. 16, 1911. Series parallel with a ground return.

1,022,943 CONDUIT; A. P. Hinsky, Brooklyn, N. Y. App. filed Jan. 16, 1911. Flexible, non-metallic, perforated helical strip of fiber.

1,022,959. SELF-ADJUSTING TROLLEY POLE; G. H. Meredith, San Francisco, Cal. App. filed July 24, 1911. Jointed pole with a conical connection.

1,022,987. ELECTRIC CLOCK; S. C. Vincent, Baltimore, Md. App. filed June 16, 1911. Improvement on White patent, No. 901,050.

1,022,993. INSULATOR; G. W. Willis, Beckley, West Va. App. filed Nov. 14, 1910. Tubular metal shell with insulating bushing for supporting a line wire.

1,023,040. MINE SIGNALING DEVICE; J. Rule, Jackson, Cal. App. filed July 28, 1911. Circuit closer for an elevator conductor.

1,023,050. TAXIMETER CONTROL; J. D. Sulsona, New York, N. Y. App. filed Jan. 10, 1910. An alarm device indicates when the taximeter is not registering when vehicle is occupied and in motion.

1,023,092. ELECTROLYTIC RECTIFIER; W. Morrison, Des Moines, Ia. App. filed Feb. 29, 1912. The anode is of bismuth and tellurium, and the electrolyte, for instance, a potassium chromate.

1,023,102. CIRCUIT-BREAKER; C. C. Badeau, Boston, Mass. App. filed Feb. 20, 1909. Direct-acting; mechanical details.

1,023,105 VARIABLE-SPEED DYNAMIC CONTROL FOR ELECTRIC MOTORS; J. D. Firmin, Philadelphia, Pa. App. filed May 31, 1911. Particularly for crane hoists.